INTERNATIONAL COUNCIL OF ENVIRONMENTAL ENGINEERING EDUCATION (ICEEE)

ICEEE-2013

4th INTERNATIONAL CONFERENCE

"TO PROTECT OUR GLOBAL ENVIRONMENT FOR FUTURE GENERATIONS"

20 – 22 of November 2013

Óbuda University

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Conference Proceedings
Part (A)

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Dear Distinguished Colleagues, Dear Friends!

It's my great pleasure to welcome all of you to the 4th International Conference of ICEEE-2013 under the title: ***"TO PROTECT OUR GLOBAL ENVIRONMENT FOR FUTURE GENERATIONS"***. This Conference is a part of the 4th International Joint Conference on Environmental and Light Industry Technologies of Sándor Rejtő Faculty of Light Industry and Environmental Protection Engineering.

The main objectives of ICEEE-2013 are:

- To bring together all academics, students, and researchers in the fields of fundamental and applied sciences of environment, environmental engineering and environmental technology to a universal discussion and find opportunities for a better future for our generations.
- To provide a forum for the discussion of most recent scientific results on the interactions of the environmental changes and human health.
- To promote research activities and exchange information between researchers.
- To provide an interactive forum for exchange of ideas by bringing together and promoting durable and strict relationships among established and young environmental scientists and researchers who operate in the field of environmental sciences.

The Focus themes of the Conference

- Air, soil & water Ecology & Pollution
- Renewing Energy & Barriers to the Use of Solar Heating & Cooling
- Biodegradation & Biodiversity
- Biogeochemical Cycles
- Environmental management, protection & Conservation
- Environmental Education and Natural Sciences
- Environmental Fluid Dynamics & Planning
- Environmental Bio- & Nanotechnology
- Global Environmental Change
- Monitoring, modelling, intervention & Environmental stimulation
- Waste management, recycling & sustainability
- Climatic Changes & Human health

I wish you a fruitful cooperational work during the Conference and I hope you will find some free time besides your scientific busy schedule to experience the vitality of Budapest to make your visit truly memorable. Also, I would like to thank the work of the organizers, and wish you all the best.
Thank you.

Prof. Dr. habil István Patkó
Dean

Program

20.11.2013 (Wednesday)

Registration	**(12:00 p.m. – 16:00 p.m.)**	**Enternce Hall**
Opening ceremony	**(14:00 p.m. – 14:45 p.m.)**	**Gara Auditorium**
Plenary Lectures	**15:00 p.m. – 16:00 p.m.**	**Gara Auditorium**

Chairman: *István Patkó*

15:00 ***Hilda FARKAS*** (Szent István University Tessedik Campus, Szarvas, **Hungary**):

LEGISLATIVE ASPECTS OF THERMAL WASTE TREATMENT AS PART OF BASIC RESEARCH DEVELOPMENT IN THE PYROLYSIS TECHNOLOGY RESEARCH CENTRE

15:30 ***Hosam E.A.F. BAYOUMI HAMUDA*** (Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering, Budapest, **Hungary**):

HEAVY METAL INTERACTION IN BIOLOGICAL PROCESSES UNDER ENVIRONMENTAL STRESS

Welcome dinner **(19:00 p.m. – 21:00 p.m.)**

21.11.2013 (Thursday)

Registration:	**8:30 a.m.**	**Entrance Hall**
Oral and Poster Scientific sessions:	**9:00 a.m. – 15:20 p.m.**	
Oral presentation (Lectures):	**09: – 15:20**	
Section (A):	**09: – 15:20**	**Gara Auditorium**

09:00 – 10:00

Chairman: *István Patkó*

09:00 ***Amina MELIANI[1], Ahmed BENSOLTANE[2], Philippe NORMAND[3]*** ([1]University Mascara, Faculty of Science, Department of Biology, Laboratory Research of Biological Systems and Geomatic, Mascara, **Algeria**, [2]University Oran (Es-senia), Faculty of Science, Department of Biology, Laboratory of Food and Industrial Microbiology, Oran, **Algeria**, [3]Université de Lyon, Centre National de la Recherche Scientifique Ecologie Microbienne, **France**):

IDENTIFICATION OF BIOSURFACTANT PRODUCING AND GAS OIL DEGRADING PSEUDOMONAS PGPR STRAINS

09:20 ***Arun Kumar NAMDEO[1], Pradeep SHRIVASTAVA[1], Abha SWARUP[2]*** ([1]Barkatullah University, Department of Environmental Science and Limnology, Bhopal (M.P.) **India**, [2]Bhoj Open University, Bhopal, **India**):

BIOMONITORING OF AQUATIC ECOLOGY AND COMPARATIVE EVALUATION OF POLLUTION STATUS OF LENTIC WATER BODIES IN CENTRAL INDIA

9:40 ***Vojtech DIRNER, Eliška KULOVÁ, Kateřina POLÍNKOVÁ, Alexander KIRALY*** (VSB – Technical University of Ostrava, Faculty of Mining and Geology, Institute of Environmental Engineering, Poruba, **Czech Republic**):

ENVIRONMENTal IMPACT OF MINING

Break: 10:00 – 10:15

10:15 – 11:15

Chairman: *Hosam B. Hamuda*

10:15 ***Jana CHOVANCOVÁ[1], Lucia BEDNÁROVÁ[1], Igor LIBERKO[2]*** ([1]University of Prešov, Faculty of Management, Department of Environmental Management, Prešov, **Slovak Republic**, [2]University of Prešov, Faculty of Management, Department of Economic Sciences and Economy, Prešov, **Slovak Republic**):

ENVIRONMENTAL, QUALITY AND SAFETY MANAGEMENT SYSTEMS IMPLEMENTATION WITH FOCUSE ON THEIR INTEGRATION

10:35 ***Ruslan MARIYCHUK, Viktoria BIRKNEROVA*** (University of Prešov, Faculty of Humanities and Natural Sciences, Department of Ecology, Prešov, Slovak Republic):

THE BIOSYNTHESIS OF SILVER NANOPARTICLES WITH VARIOUS PLANTS EXTRACTS

10:55 ***Jozef TEREK[1], Ján DOBROVIČ[2]*** ([1]Prešov University, Faculty of Management, Department of Environmental Management, Prešov, **Slovak Republic**, [2]Prešov University, Faculty of Management, Department of Management, Prešov, **Slovak Republic**):

ECOLOGICALLY ACTIVE SURFACES, THE BASIS FOR THE STUDY AND EVALUATION OF ECOLOGICAL FUNCTIONS

Break: 11:15 – 11:30

11:30 – 12:30

Chairman: *Ruslan MARIYCHUK*

11:30 ***Lýdia SOBOTOVÁ, Monika KARKOVÁ, Ružena KRÁLIKOVÁ*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

THE SOLVING OF WASTE IN WATERJET TECHNOLOGY

11:50 ***Marek MORAVEC, Miroslav BADIDA, Katarína LUKÁČOVÁ*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

ASSESSMENT OF THE EFFECTIVENESS OF ACOUSTIC NOISE MEASURES FOR VACUUM CLEANERS

12:10 ***Oleg GLUKH*** (Uzhgorod National University, Uzhgorod, **Ukraine**):

THE KINETICS OF SOIL DEHUMIFICATION DURING BURNING OF DRY VEGETATION

Lunch: 12:30 – 14:00

14:00 – 15:20

Chairman: *Lotfi GHELLAI*

14:00 ***Ruslan MARIYCHUK, Ivan SALAMON*** (University of Prešov, Faculty of Humanities and Natural Sciences, Department of Ecology, Prešov, Slovak Republic):

The APPLICATION OF LYOPHILISATION TECHNOLOGY FOR ISOLATION OF NATURAL SUBSTANCES

14:20 ***Ruzena KRALIKOVA, Hana SOKOLOVA, Lydia SOBOTOVA*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

PRACTICAL HOT STRESS ASSESSMENT METHODOLOGY FOR USE IN SLOVAKIA

14:40 ***Jozsef STEIER*** (Scientific Energy Management Association, Esztergom County, **Hungary**):

PROGRESSIVE CLIMATE MITIGATION CONCEPT FOR A SUSTAINABLE WORLD

15:00 ***Erzsébet TAKÁCS[1,2], László WOJNÁROVITS[2], Tamás PÁLFI[2,3]*** ([1]Óbuda University, Budapest, [2]Centre for Energy Research, HAS, Budapest, [3]Institute of Isotopes Co Ltd. Budapest, Hungary):

RADIATION INDUCED DEGRADATION OF ORGANIC textile dyes IN AQUEOUS MEDIA

Section (B): **09: – 15:20** **Schmalz Auditorium**

09:00 – 10:00

Chairman: *Jozsef STEIER*

09:00 ***Svitlana M. SASYN, Ivanna I. CHONKA*** (Uzhhorod National University, Uzhhorod, **Ukraine**):

RESEARCH AND DEVELOPMENT OF METHODOLOGICAL FOUNDATIONS OF ENVIRONMENTAL STUDENTS EDUCATION

09:20 ***Zdenka DŽOGANOVÁ, Miroslav BADIDA, Lenka SELECKÁ*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

SOUND PARAMETERS AFFECTING THE PSYCHICAL COMFORT IN WORKING ENVIRONMENT

09:40 ***Zoltán JUVANCZ, Rita Bodane KENDROVICS*** (Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**):

ROLE OF THE CHIRALITY IN THE ENVIRONMENTAL SCIENCE

Break: 10:00 – 10:15

10:15 – 11:15

Chairman: *Milan PAVLOVIĆ*

10:15 ***Larysa POLETAYEVA*** (Odessa State Environmental University, Odessa, **Ukraine**):

EVALUATION THE IMPACT OF “INTERNATIONAL AIRPORT ODESSA” OPERATION ON THE ATMOSPHERE

10:35 ***Léocadie ODOULAMI, Inès ADOKO, Michel BOKO*** (University of Abomey-Calavi, Faculty of Letters, Arts and Social sciences, Department of Geography and Management of territory, Laboratory Pierre PAGNEY, Climate, Water, Ecosystem and Development, Cotonou, **Republic of the Benin**):

WASTE MANAGEMENT AND SANITATION IN CITY OF OUIDAH (BENIN, WEST AFRICA)

10:55 ***Lotfi GHELLAI[1], Hafida HASSAINE[1], Zingg WALTER[2], Nihel KLOUCHE[1], Fatima NAS[1], Nadia AISSAOUI[1]*** ([1]Université de Tlemcen, Faculté des Sciences, Département de Biologie, Laboratoire de Microbiologie Appliquée à l’Agroalimentaire, au Biomédical et à l’Environnement, Tlemcen, **Algérie**, [2]Hôpitaux Universitaires de Genève, Service de Prévention et de Contrôle de l’Infection, Genève, **Suisse**):

EVALUATION OF THE EFFICACY OF ESSENTIAL OILS OF THRE AROMATIC PLANTS IN COMBINATION WITH POVIDONE-IODINE AGAINST BIOFILM OF STAPHYLOCOCCUS AUREUS

Break: 11:15 – 11:30

11:30 – 12:30

Chairman: *Lydia SOBOTOVA*

11:30 ***Olga PALANYCHKO*** (Yuriy Fedkovych Chernivtsi National University, Faculty of Geography, Department of Hydroecology, Watersupply and Waterdrain, Chernivtsi, **Ukraine**):

NATURAL-ANTHROPOGENIC SYSTEMS OF THE PEREDKARPATTIA RIVERS (WITHIN THE LIMITS OF UKRAINE): FLOODS EFFECT ANALYSIS

11:50 ***Pavol LIPTAI, Miroslav BADIDA, Marek MORAVEC, Miriama PIŇOSOVÁ*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

ANALYSIS OF THE ELECTROMAGNETIC FIELD IN THE SURROUNDINGS OF SELECTED DEVICES

12:10 ***Radoslav RUSNÁK, Miroslav BADIDA, Tomáš JEZNÝ*** (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

ULTRASOUND-ASSISTED EXTRACTION – RAPID METHOD OF ISOLATION OF ELEMENTS FORMS IN THE FRACTIONATION ANALYSIS OF SOILS

Lunch: 12:30 – 14:00

14:00 – 15:00

Chairman: *Marek MORAVEC*

14:00 ***Judit TELEGDI*** (Óbuda University, Rejtő Sándor 1Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Media technology and Light Industry, Budapest, **Hungary**):

SPECIAL SILVER NANOPARTICLES WITH ANTIFOULING ACTIVITIES

14:20 ***Vojtech DIRNER, Eliška KULOVÁ, Aleš DOBEŠ, Alexander KIRALY*** (VSB – Technical university of Ostrava, Faculty of Mining and Geology, Institute of Environmental Engineering, Poruba, **Czech Republic**):

QUALITATIVE ANALYSIS OF PROBLEMS ASSOCIATED WITH WASTE DEPOSITION IN UNDERGROUND MINE WORKINGS

14:40 ***Ferenc ZSABOKORSZKY*** (Research and Development Director, ENQUA Kft., Budapest, **Hungary**):

A FUTURE CHALLENGE FOR ENIRONMENTAL MANAGEMENT: RAISING ENERGY EFFICIENCY IN THE WATER UTILITIES SECTOR

15:00 ***Hamed A. ABDORHIM[1], Hosam E.A.F. BAYOUMI HAMUDA[2], Ibrahim ISSA[3], Yahya Mohmmed R. TARHUNI[1]*** ([1]Azzaytuna University, Faculty of Science, Department of Environmental Science, Tripoli, **Libya**, [2]Obuda University, Rejto Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**, [3]Sirte University, Faculty of Agriculture, Soil and Water Department, Sirte, **Libya**):

INVESTIGATION OF HEAVY METALS UPTAKE BY SPRING WHEAT AND COMMON BEAN PLANTS FROM SLUDGE-CONTAMINATED SOIL

Poster's session: ***09: – 15:00*** ***Aula***

Moderator: *Hosam B. Hamuda*

Abohalkuma Talah[1], Judit Telegdi[2] ([1]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Ph.D. School of Materials Sciences and Technologies, Budapest, **Hungary**, [2]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Media Technology and Light Industry, Budapest, **Hungary**):

PHOSPHONIC ACID DERIVATIVES USED IN SELF ASSEMBLED LAYERS AGAINST METAL CORROSION

Adrienn HANCZVIKKEL[1], Tamás TIRCZKA[2], Brigitta BERTA[2], Hosam E.A.F. BAYOUMI HAMUDA[1], Ákos TÓTH[2] ([1]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**, [2]National Center for Epidemiology, Budapest, **Hungary**):

SEROTYPING STREPTOCOCCUS PNEUMONIAE STRAINS ISOLATED FROM INVASIVE PNEUMOCOCCAL DISEASE AND INVESTIGATING THEIR ANTIMICROBIAL RESISTANCE

Alexandra BULEJSZA, Renáta Kitti RÉVÉSZ, Hosam E.A.F. BAYOUMI HAMUDA (Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**):

IMPROVEMENT OF RHIZOSPHERE BIOLOGICAL ACTIVITIES AND SUNFLOWER BIOMASS BY PGPR INOCULATION

Amel Guermouche MRASSI[1], Farid BENSALAH[2], Jérome GURY[3], Robert DURAN[3] ([1]Université Oran, Faculté des Sciences, Département de Biotechnologie, Oran, **Algérie**, [2]Université Oran, Faculté des Sciences, Département de Biologie, Laboratoire de Génétique Microbienne, Oran, **Algérie**, [3]*Université* de *Pau* et des *Pays* de *l'Adour*, Laboratoire de l'Environnement et Ecologie et Microbienne, **France**):

LABORATORY SCALE BIOREMEDIATION OF PETROLEUM-HYDROCARBONS CONTAMINATED SOIL BY INDIGENOUS MICROORGANISMS AND TAXONOMIC CHARACTERIZATION

Andrea PAUKÓ, Hosam E.A.F. BAYOUMI HAMUDA, István PATKÓ (Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**):

EFFECTS OF SOIL TYPES AND WASTEWATER SLUDGE APPLICATION ON PLANT GROWTH

Beata HRICOVÁ, Ervin LUMNITZER (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**):

EVALUATION OF THE ENVIRONMENTAL LEVEL OF PASSENGER CARS

Chahid BENAMMAR; Selvakumar SUBRAMANIAM; Choukri BAGHDAD; Aziz HICHAMI; Mariam BELARBI; KHAN A. Naim (UNIVERSITY Bakr Abu Bakr BELKAID Tlemcen, **Algeria**):

ANTIDIABETIC AND ANTIOXIDANT ACTIVITIES OF ZIZYPHUS LOTUS L. AQUEOUS EXTRACTS IN WISTAR RATS

Csilla dr. Perlakiné PATKÓ (University of West Hungary, Innovation Centre, Sopron, **Hungary**):

EVALUATION OF VOLATILE ORGANIC COMPONENTS OF INDOOR AIR OF A NEWLY-BUILT WOODEN FRAMEHOUSE IN THE LAST FOUR SEASONS

Dušan ŠEBO, Miroslav BADIDA, Ružena KRÁLIKOVÁ, Lýdia SOBOTOVÁ, Ladislav BARTKO (Technical University of Košice, Faculty of Mechanical Engineering, Košice, **Slovak Republic**):

THE DEFUSION OF THE WASTE WATER FROM BIOLOGICAL POLUTION OF NATURAL WATERS AND LAKES THE PROPOSAL OF APPARATUS FOR DISPOSAL OF CYANOBACTERIA

Edit Nagy[1], Judit Telegdi[2] ([1]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Ph.D. School of Materials Sciences and Technologies, Budapest, **Hungary**, [2]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Media Technology and Light Industry, Budapest, **Hungary**):

PREPARATION OF BIOACTIVE POLYESTERS FOR IMPREGNATION OF TEXTILES WITH WOUND HEALING ACTIVITIES

Eva MICHAELI[1], Martin BOLTIŽIAR[2], Jozef VILČEK[1] Danica FAZEKAŠOVÁ[3], Vladimír SOLÁR[1] ([1]University of Prešov, Faculty of Humanities and Natural Sciences, Department of Geography and Regional Development, Prešov, **Slovak Republic**, [2]Constantine the Philosopher University in Nitra, Faculty of Natural Sciences, Department of Geography and Regional Development, Nitra, **Slovak Republic**, [3]University of Prešov, Faculty of Management, Department of Environmental Management, Prešov, **Slovak Republic**):

THE CHARACTERISTICS OF NANOGEOCHORAS FORMED ON THE DUMP OF LÚŽENEC IN THE SEREĎ DURING THE LAST 30 YEARS

Fahima NABI[1], Abdelkader GHALEM[1], Ghania OUNANE[1], CHAKER-HADDADJ Assia[2], Naima GHALMI[1], Sidi Mohamed OUNANE[1] ([1]Department of Crop Husbandry, Superior National Agronomic School, Rue Hassen Badi, El Harrach, Algiers, **Algeria**, [2]University M'Hamed Bougara, Faculty of Science, Department of Biology, Boumerdes, **Algeria**):

GROWTH, YIELD AND SOLUTE ACCUMULATION RESPONSES OF ALGERIAN COWPEA (*VIGNA UNGUICULATA* (L.) WALP.) POPULATIONS TO SALINE STRESS

Farid BENSALAH[1], Amel GUERMOUCHE[2] ([1]Université Es-Sénia, Laboratoire de Génétique Microbienne, Oran, **Algérie**. [2]Université d'Oran, Département de Biotechnologie, IGMO, Oran, **Algérie**):

ISOLATION AND IDENTIFICATION BY DNA METHODS OF PSEUDOMONAS INVOLVED IN THE BIODEGRADATION OF HYDROCARBONS

F. BEKKHOUCHE, M. KERMICHE, R. MERABTI (University of Constantine, Department of Biotechnology, *Institute* of *Nutrition*, *Alimentation* and *Agro*-Alimentary *Technologies*, **Algeria**):

CHARACTERIZATION OF ISOLATES MICROBIAL IN FERMENTED WHEAT, AND ESTIMATION OF THEIR HYDROLASE'S ACTIVITIES (A-AMYLASES, PROTEASES, AND LIPASES)

István PATKÓ, Hosam E.A.F. BAYOUMI HAMUDA, Andrea PAUKÓ (Óbuda University, Rejtő Sándor [1]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering Budapest, **Hungary**):

MODIFICATION OF SUN COLLECTORS SLOP DIRECTION

István PATKÓ, Lóránt SZABÓ (Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering, Budapest, **Hungary**):

AIR-CONDITIONING EFFICIENCY IMPROVEMENT

Julia KARAVAN, Yurij YUSCHENKO (Chernivtsi Yuriy Fedkovych National University, **Ukraine**):

HYDROMORPHOLOGICAL PARAMETERS IN WATER QUALITY ASSESSMENT OF SIRET RIVER BASIN

Kamel MOUSSAOUI, Chahrazed KARA, Karima BABA AISSA, Zahr-Eddine DJAZOULI (Université SAAD Dahleb, Faculté des Sciences Agro-Vétérinaires et Biologiques, département des Sciences Agronomiques, Blida, **Algérie**):

CONTRIBUTION TO THE STUDY OF THE SEASONAL EFFECT ON THE QUALITY OF ESSENTIAL OILS OF ROSEMARY (ROSMARINUS OFFICINALIS): EVALUATION OF THE INSECTICIDAL ACTIVITY OF THE GREEN CITRUS APHID APHIS CITRICOLA (INSECTA, APHIDIDAE)

Katarína LUKÁČOVÁ, Miroslav BADIDA, Marek MORAVEC (Technical university of Košice, Faculty of Mechanical engineering, Department of Environmental Engineering, Košice, **Slovak Republic**):

DISTRIBUTION OF PARTICULATE MATTER FROM INDUSTRIAL SITE

Krisztián KOLESZÁR[1], Rita BODÁNÉ KENDROVICS[2], Zoltán JUVANCZ[2] ([1]Inspectorate for Environmental Protection, Nature Conservation and Water Management (Middle Danube-Valley) Miskolc, **Hungary**, [2]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Protection Engineering, Institute of Environmental Engineering, Budapest, **Hungary**):

VERTICAL CAVES OBSERVATION PATH OF ALSÓHEGY (AN EFFECTIVE FIELD PRACTICE FOR ENVIRONMENTAL ENGINEERING STUDENTS IN AGGTELEKI NATIONAL PARK)

Lenka ANGELOVIČOVÁ[1], Zuzana BOGUSKÁ[1], Danica FAZEKAŠOVÁ[2], Vladimír SOLÁR[3] ([1]University of Prešov, Faculty of Humanities and Natural Sciences, Department of Ecology, Prešov, **Slovak Republic**, [2]University of Prešov, Faculty of Management, Department of Environmental Management, Prešov, **Slovak Republic**, [3]University of Prešov, Faculty of Humanities and Natural Sciences, Department of Geography and Regional Development, Prešov, **Slovak Republic**):

IMPACT OF OLD ENVIRONMENTAL LOADS TO THE SELECTED ENVIRONMENTAL COMPONENTS

Lucia BEDNÁROVÁ[1,2] ([1]University of Prešov, Faculty of management, Prešov, **Slovak Republic,** [2]Rzeszów University of Technology, Faculty of management, Rzeszów, **Poland**):

TRENDS IN ENVIRONMENTAL FIRM MANAGEMENT

Lýdia SOBOTOVÁ, Katarína LUKÁČOVÁ, Ružena KRÁLIKOVÁ (Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmental Engineering, Košice, **Slovak Republic**):

THE DUST MEASURING IN PROGRESSIVE TECHNOLOGY OF MATERIAL CUTTING

Milan PAVLOVIĆ, Marko SIMIĆ, Aleksandar ĐURIĆ , Aleksandar TOMOVIĆ (University of Novi Sad, Technical Faculty “Mihajlo Pupin”, Đure Đakovića bb, Zrenjanin, **Serbia**):

CONTRIBUTION OF IPA CBC PROJECTS IN THE DEVELOPMENT OF ACADEMIC THOUGHT ON THE SUSTAINABLE DEVELOPMENT

Milan PAVLOVIĆ[1], Aleksandar TOMOVIĆ[1], Marko SIMIĆ[1], Aleksandar PAVLOVIĆ[2] ([1]University of Novi Sad, Technical Faculty „Mihajlo Pupin“, Zrenjanin, **Serbia**, [2]PFB DESIGN, **Serbia**):

THE SUSTAINABILITY OF THE ELV RECYCLING SYSTEM IN THE REPUBLIC OF SERBIA

Miriama PIŇOSOVÁ[1], Miriam ANDREJIOVÁ[2], Pavol LIPTAI[1] ([1]Technical University of Košice, Faculty of Mechanical Engineering, Department of Environmentalistics, Košice, **Slovak Republic**,

[2]Technical University of Košice, Faculty of Mechanical Engineering, Department of Applied Mathematics and Informatics, Košice, **Slovak Republic**):

RISK ASSESSMENT OF EXPOSURE TO VIBRATION IN THE WORKING ENVIRONMENT

Moghtet SNOUSSI[1,2,3], Nawel Nahal BOUDERBA[1], Hamid KADI[1], Abdellah MOUSSAOUI[1] ([1]Laboratoire de ressources végétales et sécurité alimentaire des zones semi-arides du Sud-Ouest of **Algeria,** Bechar Univ., Bechar, **Algeria**, [2]Laboratoire d'analyse des grands moulins du Dahra, Mostaganem, **Algeria**, [3]Département des sciences de la terre et l'univers-C. Univ. Tindouf, **Algeria**):

SALSOLA VERMICULATA, ANTIFUNGAL AND ANTIMYCOTOXICOLOGICAL ACTIVITIES OF HYDRO-METHANOLIC EXTRACTS AGAINST AFLATOXIGENIC MOULDS ISOLATING FROM THE IMPORTED FRANCE SOFT WHEAT MARKETED IN THE NORTH AND SOUTHERN OUEST OF ALGERIA

Mohammed MOURADI[1,2], Ablaa KABADDJ[1], Bouchra MAKOUDI[1], abdelaziz BOUIZGAREN[2], Cherki GHOULAM[1] ([1]Unit of Plant Biotechnology and Symbiosis Agro-physiology, Faculty of Sciences and Techniques, Marrakech, **Morocco**, [2]Unit of Plant Breeding, National Institute for Agronomic Research, Marrakesh, **Morocco**):

EFFECT OF WATER DEFICIT ON GROWTH AND SOME AGROPHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS IN MORROCCAN ALFALFA-RHIZOBIA SYMBIOSIS

Noujoud GABED, Baba Ahmed Mohamed BEY, Habiba DRICI (ES Senia University, Biotechnology department, Oran, **Algeria**):

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CHANGES OF SOIL PROPERTIES TEXTURES AFTER OVERFLOWING

Radoslav RUSNÁK, Miroslav BADIDA, Tomáš JEZNÝ (Technical University of Kosice, Faculty of Mechanical Engineering, Department of Environmentalistics, Kosice, **Slovak Republic**):

ULTRASOUND-ASSISTED EXTRACTION – RAPID METHOD OF AN ELEMENT FORM ISOLATION IN THE FRACTIONATION ANALYSIS OF SOILS

Ruzena KRALIKOVA, Miroslav BADIDA, Lydia SOBOTOVA (Technical University of Kosice, Faculty of Mechanical Engineering, Department of Environmentalistics, Kosice, **Slovak Republic**):

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EFFECT OF PHYTOSANITARY PROTECTION ON SOIL FAUNA

Soufiane RAHAL, R. KHALLADI, N. MOULAI-MOSTEFA (University of Medea, Materials and Environmental Laboratory, Ain D'Heb, Medea, **Algeria**):

FORMULATION AND CHARACTERIZATION OF MICRO-EMULSIONS BASED ON ANIONIC SURFACTANTS, MINERAL OIL AND BRINE

Victor G. BAR'YAKHTAR[1], Yaroslav BYKOVSKIY[2] ([1]Institute of Magnetism, National Academy of Science of Ukraine and Ministry of Education of Ukraine, Kyiv, **Ukraine**, [2]National Pedagogical Dragomanov University, Kyiv, **Ukraine**):

NUCLEAR POWER IS ONE OF THE WAYS TO SOLVE THE ENERGY NEEDS OF HUMANITY AND THE PROTECTION OF THE ENVIRONMENT

ICEEE Activities in 2012	(15:30 p.m. – 16:15 p.m.)	Gara Auditorium
Closing ceremony	(16:15 p.m. – 16:45 p.m.)	Gara Auditorium
Conference Banquet	(19:00 p.m. – 22:30 p.m.)	

22.11.2013 (Friday)

Start: From 08:30 a.m. to 16:00 p.m.

Scientific Excursion

Social Programme

Good bye lunch

Content

SESSION OF PLENARY LECTURES

LEGISLATIVE ASPECTS OF THERMAL WASTE TREATMENT AS PART OF BASIC RESEARCH DEVELOPMENT IN THE PYROLYSIS TECHNOLOGY RESEARCH CENTRE

Hilda FARKAS

Szent István University Tessedik Campus, *1-3 Szabadság u, Szarvas, H-5540 Hungary*

Abstract: *Background and aims**:** St István University has won funding for the project „Basic Research Development in the Pyrolysis Technology Research Centre of St István University" (TÁMOP-4.2.2.A-11/1/KONV-2012-0015). This aims to establish a knowledge centre on the cracking methods. This paper relates to the analysis of legislative aspects to identify legislative gaps and to prepare recommendation package for policy-makers. Methods**:** A complex regulatory picture has been created, in which we have analyzed all acts of the EU linked to thermolysis-based waste-management procedures. We have also compared these with the national regulatory elements. The policy recommendation package will only be realized in a future phase, this analysis will identify regulatory shortcomings which have to be brought to the attention of the lawmakers. Results**:** The technological regulations of thermolysis-based technologies cannot be found in a single judicial act, but have to be compiled from numbers different legal pieces. Different law refers to licensing in general, special decree on waste incineration, and when needed, animal waste decrees. At the same time, the special requirements of the permitting can be found in the Environmental Protection Law, and decree of environmental impact assessment, the BAT, and the rules of integrated environmental permitting. The emission limit values of the pollution components must be established following the degree on waste incineration. Therefore it is increasingly difficult for those who wish to install or use such technologies to navigate through in the thick of the law. The first product of our research also serves as a guide to locating which economic regulatory tools hinder or aid their operation.*

Keywords: *waste management, waste thermal treatment, thermolysis, legislation, Technology Research Centre*

Background of the problem and aims

In the framework of the Social Renewal Operational Program (TÁMOP) of the New Széchenyi Plan, Tessedik Campus (Szarvas) of College of Economics, Agrarian and Health Sciences of St István University has won funding for the project „Basic Research Development in the Pyrolysis Technology Research Centre of St István University" (TÁMOP-4.2.2.A-11/1/KONV-2012-0015).

The research focuses on the cracking method (pyrolysis and thermolysis) which is in the centre of interest of both laboratory researches and inventers' copyright activities both abroad and inland. The University has established a research group involving national and foreign researchers, Professors of Hungarian Academy of Sciences (MTA), young researchers, PhD students and entrepreneurs.

The main goals and expected results of the research-development is establishing an independent technological knowledge centre which is able to analyze and evaluate existing and new future pyrolysis technologies and methods, able to evaluate and qualify the end-products and environmental releases of certain technologies through independent and

objective measurements, and by working out and testing and measuring systems as well as qualifying methods and ratability examinations needed for the advising process.
Further goals of the research program to collect information available in the topic, establish contacts and build partnerships, exchange information between research centers and entrepreneurships, create technical and scientific study programs corresponding to needs of market, and work out professional policy recommendation package (legal regulation, licensing, support system) in order to give professional and scientifical support for decision making
This paper relates to the analysis of legislative aspects, which aims to collect all legal acts concerning thermolysis as part of waste treatment methods, to identify legislative gaps and to prepare recommendation package for policy-makers. An additional goal is to establish a unified, firm standpoint on thermolysis, as a part of waste-treatment, and energy, or raw material production technology.

Methods

In the first half of the research, we have created a complex regulatory picture, in which we have analyzed all acts of the European Union that can be linked to thermolysis-based waste-management procedures. We have also referred these with the national regulatory elements. As part of the program, we have established the following surveying phases:

- Overview of thermal cracking technologies in EU and national legal and economic regulations and permitting procedures
- Survey of economic regulatory schemes for products of thermal cracking waste management procedures and their sale possibilities
- Compilation and analysis of best regulatory practices and problems in EU Member States
- Compilation of industrial intellectual property rights

When working on technical aspects of the regulatory project, we took additional care in analyzing the following:

- Permitting
- Operating (waste acceptance, technological requirements, emissions)
- Inspection, reporting. data supply
- Closure

When analyzing the economic regulatory tools we focused on the following:

- Economic regulations pertaining to waste generation (product charge, take back obligation, mining tax, extraction tax)
- Economic regulations pertaining to waste management (landfill tax, environmental load fee, financial guarantee, and financial provisioning)
- Economic regulations pertaining to the end products (excise tax, green power takeover)

Although the policy recommendation package will only be realized in a future phase of the project, the analysis done thus far allowed for identifying regulatory shortcomings which have to be brought to the attention of the lawmakers. After the compilation of the recommendation package, a large-scale consultation will also happen as part of the project, with civil societies and professional stakeholders as well. Following this professional debate, the recommendation package will be finalized and sent to the lawmakers and relevant authorities.

Results

We have established that the technological regulations of thermolysis-based technologies cannot be found in a single judicial act, but have to be compiled from numbers different legal pieces. This is the case both in EU and Hungarian regulations, which makes the work of creating and managing projects harder for those regulated.
The general requirements of licensing can be found in the Waste Law and pertinent executive decrees, especially in decrees on site regulations, waste incineration, regulation of waste management permitting, and when needed, animal waste decrees. At the same time, the special requirements of the permitting can be found in the Environmental Protection Law, specifically in the government decree of environmental impact assessment, the BAT, and the rules of integrated environmental permitting.
Prior to the acceptance of incoming waste, the mass of all waste categories has to be identified according to waste list categories, and in the case of hazardous waste representative samples must be taken. During operation, the total TOC content of bottom ash and slag has to be smaller than 3%, or the ignition loss less than 5% of the remaining mass of the dry material. Technological parameters: gas temperature min. 2 mp on 850^{o}C, or 1100^{o}C when the organic chlorine component is greater than 1%. The emission limit values of the pollution components must be established following the degree on waste incineration.
Care must be taken to monitor the emissions and the environmental state in regulated intervals as set forth in the permit. Data must be supplied by the plant operator as set forth on the government decree of waste recording and reporting requirements. Other data supply is regulated by the air and sub-surface water law.
The parts of the Industrial Emission Directive must be taken into consideration in the case of the license being issued after 2013 January 7, and reporting of a baseline and closure end-stage environmental conditions is required. If necessary, remediation tasks must be accomplished in view of the current and the approved future land use.
During our examination of economic regulatory tools, we have determined that the application of product charge an take-back obligation limits the access to raw materials of thermolysis-based technologies, but at the same the time the landfill tax and environmental load fee increases the use of such technologies. The creation of provisions, financial guarantees increases management costs, thus is disadvantageous. Excise regulation in some instances is beneficial for thermolysis-based waste management procedures, and the obligatory purchase cost of electric energy derived from waste is also advantageous, as it aids in the use of such technologies from the product side by establishing relevant market requirements.

Conclusions

Waste management procedures based on thermolysis may play a major part in the waste management hierarchy, because the disposal of waste they use is not needed, while these technologies are capable of using all materials which cannot be recycled due to insufficient purity or lack of capacity for recycling.
During our study, we have established that no comprehensive regulatory environment exists which would allow a general overview of the technological regulations of such technologies based on the knowledge of a few statues. This fragmentation is true not only for Hungarian regulations, but for EU-level regulations as well. Therefore it is increasingly difficult for those who wish to install or use such technologies to navigate through in the thick of the law. The first product of our research is a comprehensive study that systematizes the required judicial

knowledge for the implementation of such technologies, and serves as a guide to locating which economic regulatory tools hinder or aid their operation.
In the next phase of our research, we will locate the shortcomings of the regulations, and make public our policy recommendation package, especially relevant for lawmakers, to aid in the creation of a more unified, judicially more readily stable environment for thermolysis-based technologies. These technologies must be an organic part of a modern waste management system.

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HEAVY METAL INTERACTION IN BIOLOGICAL PROCESSES UNDER ENVIRONMENTAL STRESS

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Abstract: *Heavy metal pollution represents an important environmental problem due to their toxic effects, and their accumulation in the food chain leads to serious ecological and health problems. Heavy metal remediation through common physicochemical technologies is expensive and unsuitable in case of voluminous effluents containing complexing organic matter and low metal contamination. Biotechnological approaches that are designed to cover such niches have, therefore, received great deal of attention in the recent years. Heavy metal contamination of agricultural soils is a major concern to food production all over the world. Agricultural soil heavy metal contamination is from wastewater irrigation, application of sewage and air deposition from the atmosphere and is of great importance because of its implications for human health. Heavy metal stress is one of the major problems affecting agricultural productivity of plants. Natural flora show relative differences in their heavy metal tolerance capacity. Some plants grow well in a soil enriched with toxic levels of heavy metals while others could not grow. The scientific observations on several of these plants have indicated that glutathione is a major player determining their relative tolerance. Additionally, several natural plant species have been identified showing the heavy metal accumulator behaviours. The natural heavy metal accumulators could be a potential source for genetic manipulation of other important agricultural crop plants. An increase in metal concentration also influences the soil microbial properties, especially respiration and enzymatic activity that serve as good indicators of metal pollution. Several studies have shown a negative relationship between heavy metal concentration and microbial activities, such as respiration, mineralization, nitrification, intracellular and extracellular enzymatic activities and microbial community biomass and structure.*

Keywords: ***Biological processes, heavy metal, environmental risk, contamination***

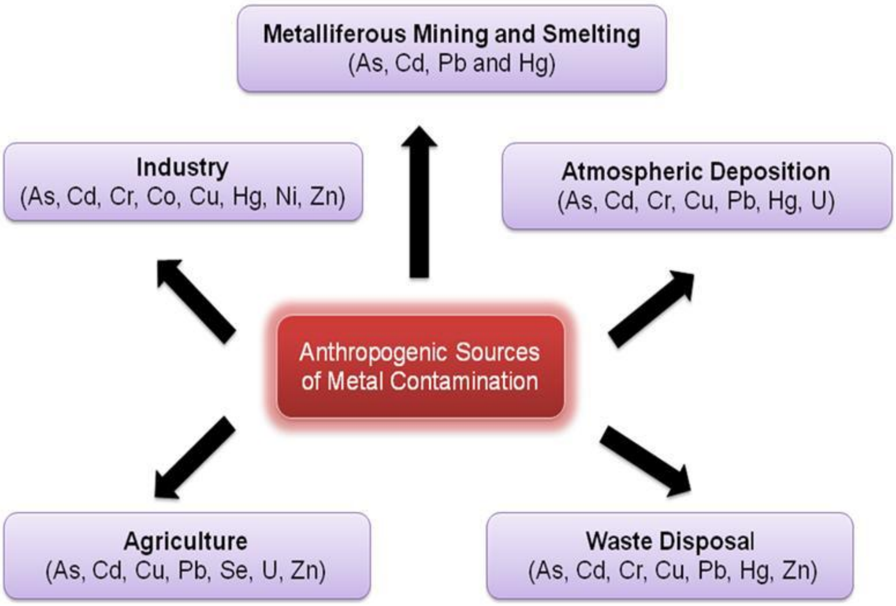
INTRODUCTION

Heavy metals have larger atomic weight and complex electronic configuration. Sources of environmental pollution by heavy metals: All human activities including, heavy industries, agrochemicals, wastewater sludge, wastes by various industries etc. Heavy metals can become mobile in soils depending on soil pH and their speciation. Industry, agriculture, extensive mining, military operations and other human activities have led to the accelerated release of metals to toxic levels into the ecosystem. These toxic metals impose serious environmental problems and pose health risks to living organisms. To maintain sustainable agriculture, it is essential to understand how plants respond to and cope with these toxic metals in their habitat.

Heavy metals are one of the major sources of environmental pollutants and exist in soil as free metal ions, soluble metal complexes, exchangeable metal ions, organically bound metals, precipitated or insoluble compounds like oxides, carbonates and hydroxides or they may form a part of silicate materials (Leyval et al., 1997). Heavy metals can accumulate in biological systems and ultimately be introduced into food web via different mechanisms. Heavy metal contamination thus poses a serious threat to both the ecosystem and human and requires expensive cleanup costs. Heavy metals such as Cu, Fe, Mn, Ni and Zn are essential for plant growth and are important constituents of many enzymes, whereas metals such as Al, As, Cd, Cr, Hg, Pb, Sb and Se are nonessential and toxic above certain threshold levels (Panda and Choudhury, 2005).

An increase in metal concentration also influences the soil microbial properties, especially respiration and enzymatic activity that serve as good indicators of metal pollution. Several studies have shown a negative relationship between heavy metal concentration and microbial activities, such as:

- respiration (Bääth, 1989),
- mineralization (van Beelen et al., 2001),
- nitrification (Smolders et al., 2001),
- intracellular and extracellular enzymatic activities (Yeates et al., 1994) and
- microbial community biomass and structure (Kelly and Tate, 1998).



Anthropogenic activities leading to the contamination of soils with heavy metals (Source: *Ahemad et al., 2012*)

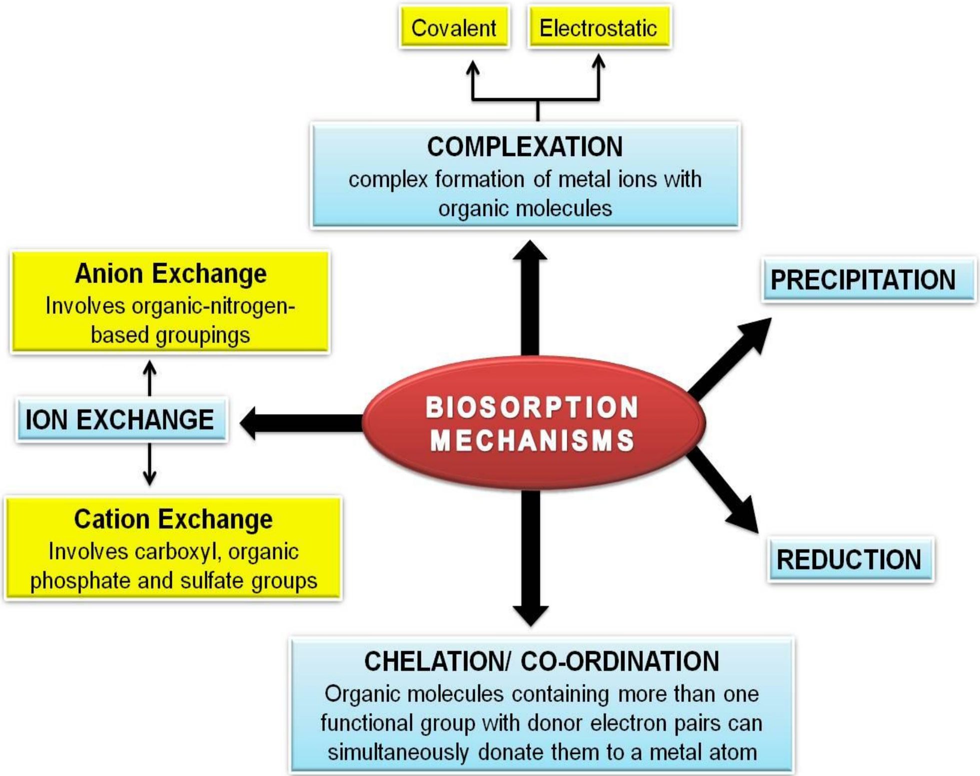
Conventional technologies, such as:

- precipitation,
- filtration,
- ion exchange,
- reverse osmosis,
- oxidation,
- reduction and

- membrane separation, are often inadequate to reduce heavy metal concentrations in the environment to acceptable regulatory standards.

However, bioremediation is well-known to be effective in eliminating the toxicity caused by metals. Bioremediation is the process whereby the organic wastes are biologically degraded under controlled conditions to an innocuous state or to levels below concentration limits established by regulatory authorities (Mueller et al., 1996).

Many bacterial strains contain genetic determinants of resistance to heavy metals. These resistance determinants are often found on plasmids and transposons which are exploited in bioremediation.



The term adsorption is used in a general way and it incorporates numerous passive (non-metabolic) mechanisms (Source: Ahemad and Kibret, 2013)

Many metals are essential to living organisms but some of them are highly toxic or become toxic at high concentrations.

- Fe (haemoglobin),
- Cu (respiratory pigments),
- Zn (enzymes),
- Co (Vitamin B12),
- Mo and Mn (enzyme).

Heavy metals such as Hg, Pb, Sn, Ni, Se, Cr and As which are generally not required for metabolic activity and are toxic to living organisms at quite low concentrations (Meria, 1991).

Microorganisms have developed mechanisms to tolerate the metals either by:

- presence of heavy metals through efflux,
- complexation, or
- reduction of metal ions or
- to use them as terminal electron acceptors in anaerobic respiration (Haferburg and Kothe, 2010).

Bacteria that are resistant to and grow on metals play an important role in the biogeochemical cycling of those metal ions. Trace metal ions are required for many biological processes in which biomacromolecules are engaged. These molecules frequently contain metal ions on the active site, e.g., in:

- carboxypeptidase,
- alkaline phosphatase,
- carbonic anhydrase,
- cytochromes,
- haemoglobin,
- ferredoxins, etc.

The metal ions in such substances are directly involved in the mechanism of the biological process which the macromolecules are designed to mediate.

BIOACCUMULATION OF METALS IN LIVING ORGANISMS

The extent of bioaccumulation of metals is dependent on the:

- total amount,
- bioavailability of each metal in the environmental medium
- route of uptake,
- storage and excretion mechanisms.

The requirements of different organisms for essential metals vary substantially but optimal concentration ranges are narrow and frequently under careful homeostatic control. Excess metal concentration in an organism must be actively excreted, compartmentalized in cells or tissues, or metabolically immobilized. Some metal escape all these actions causing toxic and other adverse effects (Chapman et al., 1996).

HEAVY METAL IN OUR LIFE

Heavy metal pollution represents an important environmental problem due to their toxic effects, and their accumulation throughout the food chain leads to serious ecological and health problems. Biologically active metal ions can sometimes be displaced by other metal ions. Thus the active site of macromolecule is a potential locus for the interaction of toxic metals. Metal ions that are essential for biological activity at one concentration become toxic at different concentration.

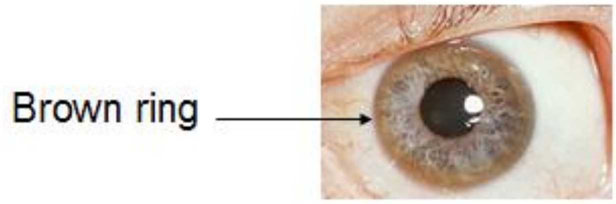
Diseases

Diseases that results from an excess of essential metals are well known e.g.:

- Wilson's disease from an overlap of Cu and
- Hemochromatosis from an overlap of Fe.

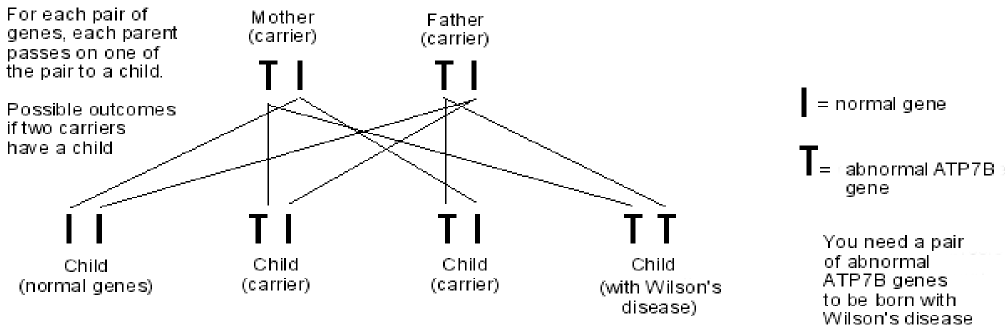
Wilson's disease from an overlap of Cu

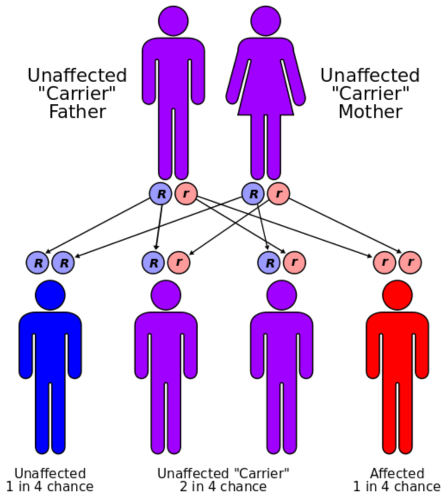
Copper may build up in the cornea of the eye. This causes a characteristic feature called Kayser-Fleischer rings - a brownish pigmentation of the cornea.



Wilson's disease is a genetic disorder in which too much Cu builds up in the body, mainly in the liver and brain. Wilson's disease is a rare inherited disorder that affects about 1 in 30,000 people. Wilson's disease or hepatolenticular degeneration is an autosomal recessive genetic disorder in which Cu accumulates in tissues. Without any treatment, the build-up of Cu can cause serious symptoms. Treatment is with medication to remove the excess Cu and/or to prevent a further build-up of Cu. The condition is due to mutations in the Wilson disease protein (ATP7B) gene. A single abnormal copy of the gene is present in 1 in 100 people, who do not develop any symptoms (they are carriers). Too much Cu in the liver cells (hepatocytes) is harmful and leads to liver damage. Damage to brain tissue mainly occurs in an area called the lenticular nucleus. Wilson's disease is sometimes also called hepatolenticular degeneration.

How is Wilson's disease inherited?





Liver problems

Symptoms of liver problems often develop first. The toxic effect on the liver cells can cause hepatitis (inflammation of the liver) which may cause jaundice, abdominal pain and vomiting. If left untreated, damage to liver cells causes scarring of the liver (cirrhosis). Eventually, severe cirrhosis and liver failure develop in untreated cases, causing severe problems.

Brain problems

As Cu deposits in the brain it can cause various symptoms:

- Physical symptoms such as an odd type of tremor in the arms, slowness of movement, difficulty with speech, writing problems, difficulty swallowing, an unsteady walk, headaches, seizures.
- Psychological symptoms such as depression, mood swings, inability to concentrate. Affected people may become very argumentative and emotional and may seem to have a change in personality.

If left untreated, the accumulation of copper in the brain can lead to severe problems such as severe muscular weakness, severe rigidity, and dementia.

Other problems

Include:

- anaemia,
- kidney damage,
- heart problems,
- pancreatitis (inflamed pancreas),
- menstrual problems and repeated miscarriage in women, and
- premature osteoporosis (thinning of the bones).

Hemochromatosis

Hemochromatosis is known as:

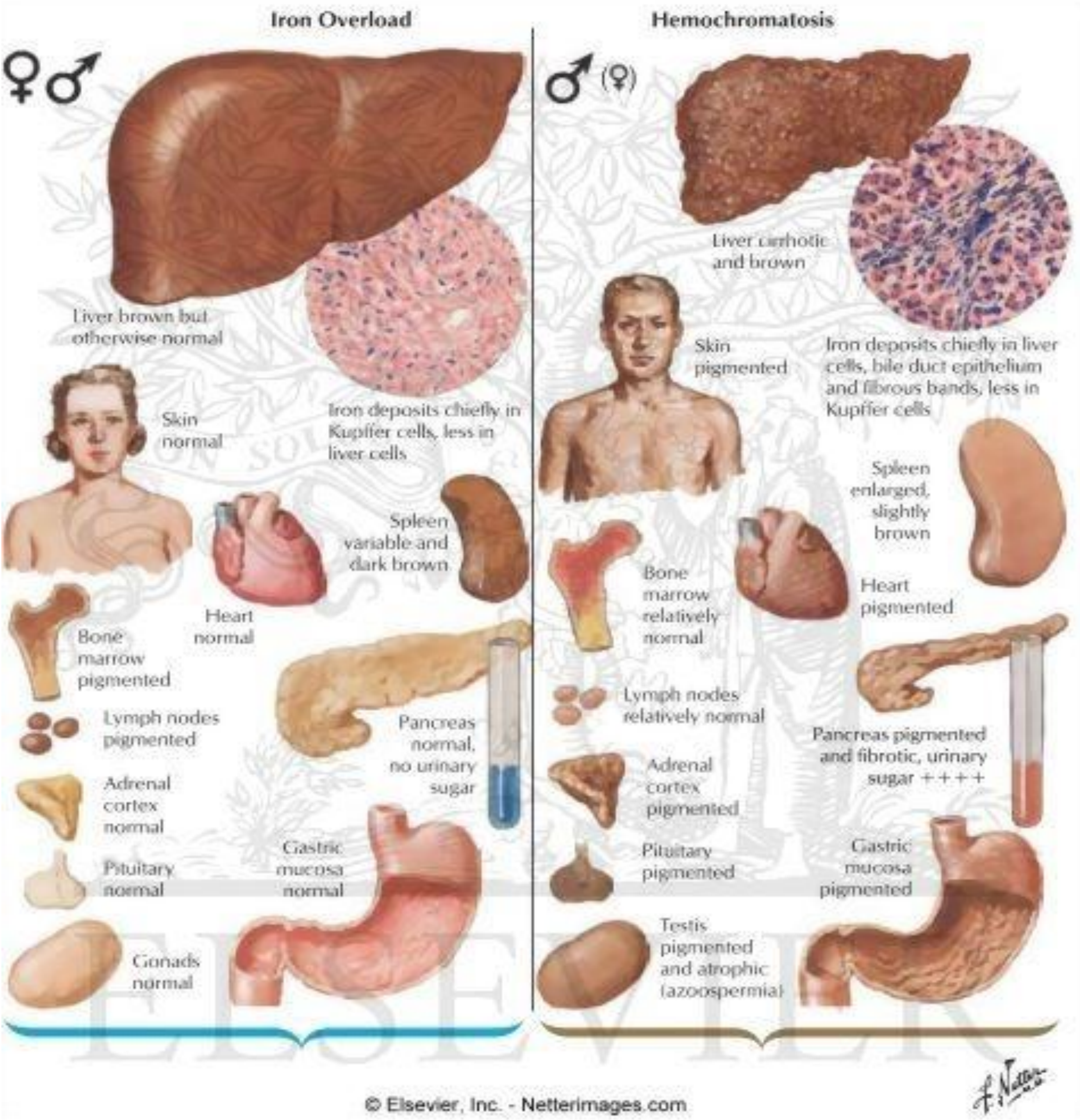
- Fe overload,
- bronze diabetes,

- hereditary hemochromatosis and
- familial hemochromatosis.

In medicine, iron overload indicates accumulation of Fe in the body from any cause. The most important causes are:

- hereditary haemochromatosis, a genetic disorder, and
- transfusional Fe overload, which can result from repeated blood transfusion.

Humans, like most animals, have no means to excrete excess iron. Excess iron accumulates in tissues and organs disrupting their normal function. A disorder due to the deposition of hemosiderin in the parenchymal cells, causing tissue damage and dysfunction of the liver, pancreas, heart, and pituitary. Full development of the disease in women is restricted by menstruation, pregnancy, and lower dietary intake of Fe. Acquired hemochromatosis may be the result of blood transfusions, excessive dietary Fe, or secondary to other disease.



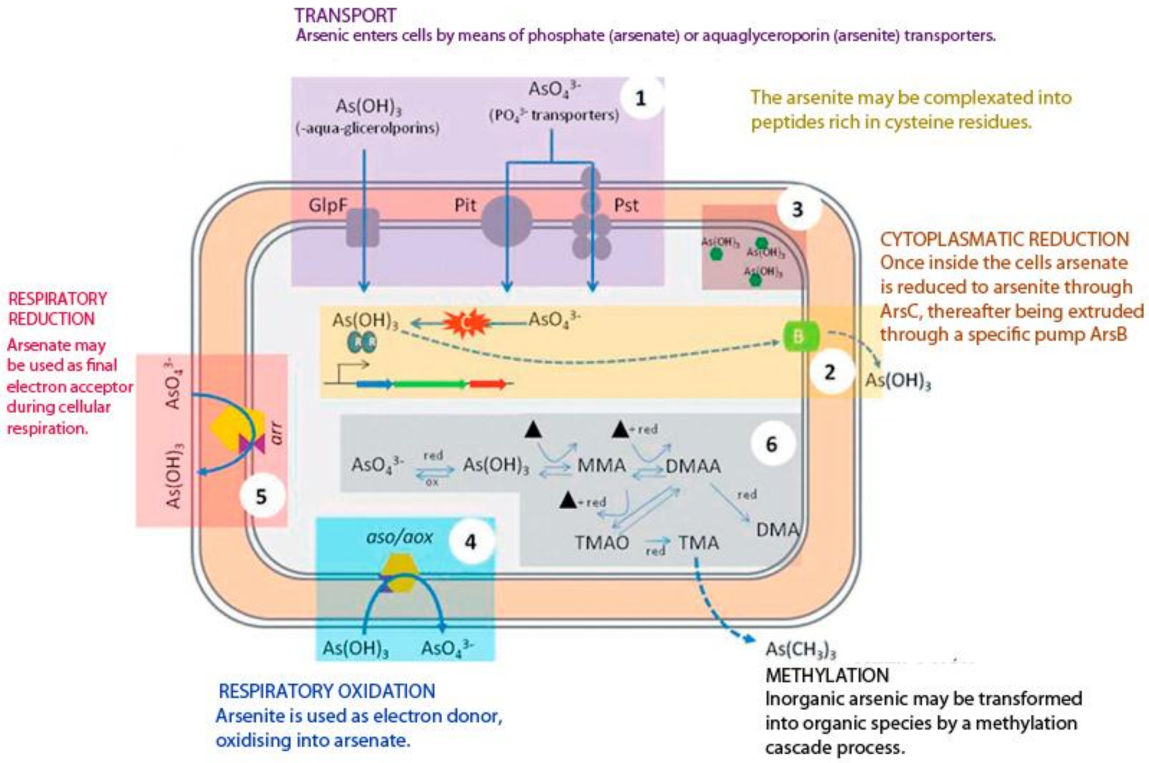
BIOLOGICAL EFFECTS OF METALS

The biological effects of metals are related to their chemical characteristics. Metals such as Cu, Fe, and Mn are particularly adept at catalyzing redox reactions within biological systems. Zinc is a nutrient metal that in high dosage can paradoxically promote oxidative toxicity. Heavy metals (Pb and Cd) and metalloids (As) can induce oxidative toxicity but more likely work by binding to proteins and interfering with metal transport and protein function. Lead and methyl-mercury are toxic in biological processes. Unfortunately, it appears that excess metal exposure may be a common source of neurotoxicity in multiple populations around the world. Although metals have multiple effects on biological systems, an understudied effect is their role in programming gene expression.

A growing body of evidence suggests that metals may influence epigenetic phenomena which regulate the expression of genes and ultimately their protein products. Metal pollution is considered hazardous to biological systems because of their oxidative and carcinogenic potential. In the past metals were considered to bind on the nucleic acids, by reacting in sites of the cellular DNA and cause mutations, adducts or complexes. Also, metal cations were found to affect DNA replication, but at very high concentrations *in vitro*. Strand scission, depurination, cross-linking and base modifications are the major lesions formed after exposure of experimental animals to carcinogenic metals. Scientists observed that carcinogenic metals caused damage in nuclear chromatin similar to oxygen free radicals and other free radical species. Recent studies found that metals can act as carcinogens through oxidative mechanisms, generating free radicals and reactive oxygen species (ROS), which attack and damage DNA and important enzymatic proteins. The toxicology and carcinogenicity of many heavy metals is another important environmental concern of the scientific community.

METAL-MICROBE INTERACTION

For example, microorganisms play an important role in the biogeochemical cycle of arsenic; they are largely responsible for the biotransformation and mobilization of this metalloid in the environment. Microbial enzymatic activities catalyse the conversion of the various species of arsenic to forms with different solubility, mobility, bioavailability and toxicity. Many microorganisms have developed arsenic resistance mechanisms but, surprisingly enough, some of them are capable of using arsenic or even need it for their normal physiology (Páez-Espino et al., 2009).



Main arsenic transformation and resistance mechanisms in bacteria. (1) Arsenic enters the cell through the phosphate (arsenate) or aquaglyceroporins (arsenite) channels (2). Once inside the cell arsenate is reduced to arsenite through ArsC, thereafter being extruded through ArsB. (4) Arsenite can serve as electron donor, oxidising into arsenate. (6) Arsenate may be used as final electron acceptor during cellular respiration. (3) Inorganic arsenic may be complexated with peptide cysteine residues or transformed into organic species from complexes with methylation cascades (6). (Source: Páez-Espino et al., 2009)

OLIGODYNAMIC EFFECT

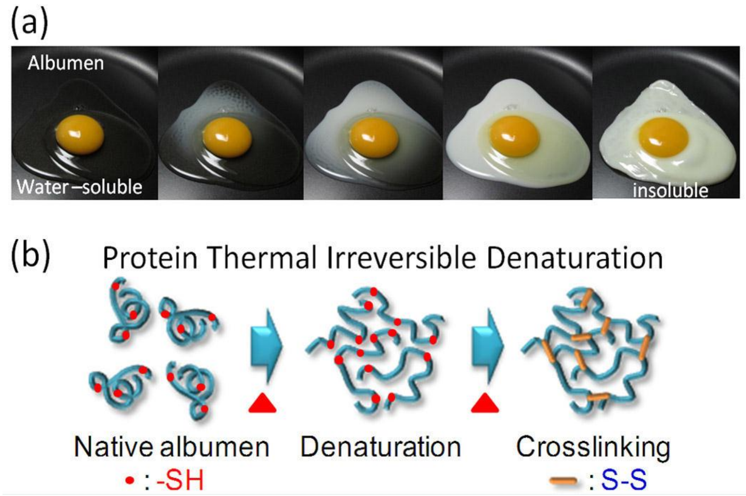
The detrimental effect of small amount of heavy metals on microorganisms is called Oligodynamic Effect. This action can be seen when we place a coin or other clean piece of metal containing silver or copper on a culture media on an inoculated Petri Plate.

Oligodynamic Effect

The oligodynamic effect as a toxic effect of metal ions on living cells, of prokaryotic and eukaryotic microorganisms, and non-living viruses, even in relatively low concentrations. This antimicrobial effect is shown by ions of mercury, silver, copper, iron, lead, zinc, bismuth, gold, aluminium, and other metals.

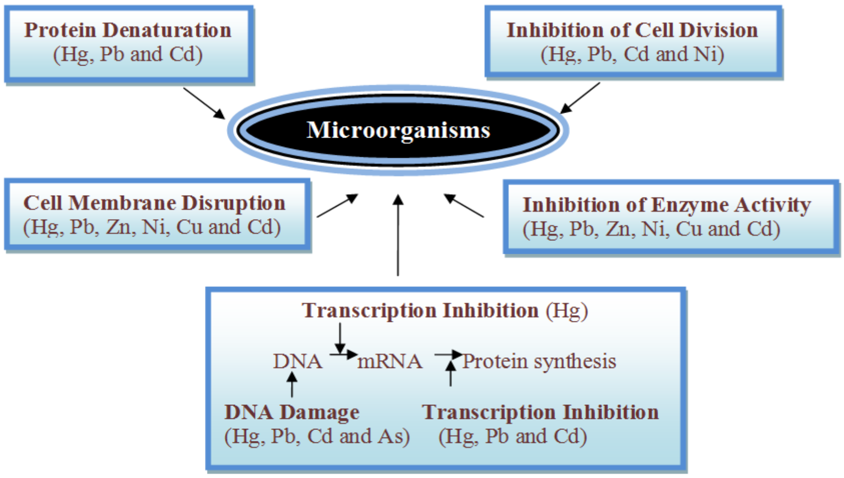
MODE OF ACTION

The exact mechanism of action is still unknown. Data from silver suggest that these ions denature proteins (enzymes) of the target cell or organism by binding to reactive groups resulting in their precipitation and inactivation. Silver inactivates enzymes by reacting with the sulfhydryl groups to form silver sulfides. Silver also reacts with the amino-, carboxyl-, phosphate-, and imidazole-groups and diminish the activities of lactate dehydrogenase and glutathione peroxidase. Gram-positive and Gram-negative bacteria are in general affected by the oligodynamic effect, but they can develop a heavy-metal resistance, or in the case of silver a silver-resistance. Viruses in general are not very sensitive. The toxic effect is fully developed often only after a long time (many hours).



Applications

Certain metals, e.g. brass and copper are known to be far more poisonous to bacteria than others (such as stainless steel and aluminium), which is why they are used in mineral sanitizers for swimming pools and spas. Brass is used to manufacture cosmetic containers, especially those used to apply kohl or kajal to the eye lids, in the Middle East and Asia. Many infections can spread by doorknobs. Brass doorknobs automatically disinfect themselves in about eight hours, while stainless steel and aluminium knobs never do. Brass doorknobs therefore tend to be more sanitary than stainless or aluminium doorknobs.



Heavy metal-toxicity mechanisms to microbes (Source: Khan et al., 2009)

METALS IN AGRICULTURE

Heavy metal contamination is a worldwide problem that results in bioaccumulation in the food chains, posing a direct threat to wildlife and human health. Although naturally present in soils, they rarely occur at toxic levels. Heavy metal contamination therefore largely is anthropogenic— a result of industrial manufacturing, agriculture, combustion of fossil fuels, and road traffic, among other causes (Serbula et al. 2012).

Contamination of agricultural soil by heavy metals has become a critical environmental concern due to their potential adverse ecological effects. Such toxic elements are considered as soil pollutants due to their widespread occurrence, and their acute and chronic toxic effect on plants grown of such soils. Heavy metal contamination of agricultural soils is a major concern to food production all over the world. Agricultural soil heavy metal contamination is from wastewater irrigation, application of sewage sludge and air deposition from the atmosphere and is of great importance because of its implications for human health. Natural flora show relative differences in their heavy metal tolerance capacity. Some plants grow well in a soil enriched with toxic levels of heavy metals while others could not grow. The scientific observations on several of these plants have indicated that glutathione is a major player determining their relative tolerance.

Additionally, several natural plant species have been identified showing the heavy metal accumulator behaviours. The natural heavy metal accumulators could be a potential source for genetic manipulation of other important agricultural crop plants. The regulatory limit of cadmium (Cd) in agricultural soil is 100 mg/kg soil (Salt et al., 1995). But this threshold is continuously exceeding because of several human activities. Plants exposed to high levels of Cd causes reduction in photosynthesis, water uptake, and nutrient uptake. Plants grown in soil containing high levels of Cd show visible symptoms of injury reflected in terms of chlorosis, growth inhibition, browning of root tips, and finally death (Mohanpuria et al., 2007).

Soil is contaminated with zinc (Zn) in addition to Cd by the sewage sludge or urban composts, fertilizers, emissions from municipal waste incinerators, residues from metalliferous mining, the metal smelting industry, and other human activities. Zn is an essential nutrient for living organisms, while Cd is nonessential and potentially toxic for higher plants, animals and humans. Concentrations of Zn found in contaminated soils frequently exceed to those required as nutrients and may cause phytotoxicity. Zn concentrations in the range of 150 to 300 mg/kg have been measured in polluted soils (Warne et al., 2008). High levels of Zn in soil inhibit many plant metabolic functions; result in retarded growth and cause senescence. Zinc toxicity in plants limited the growth of both root and shoot (Fontes and Cox, 1998). Zinc toxicity also causes chlorosis in the younger leaves, which can extend to older leaves after prolonged exposure to high soil Zn levels (Ebbs and Kochian, 1997). Also, the effect of Zn toxicity is the appearance of a purplish-red colour in leaves, which is ascribed to phosphorus (P) deficiency (Lee et al., 1996).

The chlorosis may arise partly from an induced iron (Fe) deficiency as hydrated Zn^{2+} and Fe^{2+} ions have similar radii (Marschner, 1986). Excess Zn can also give rise to Mn and Cu deficiencies in plant shoots. Such deficiencies have been ascribed to a hindered transfer of these micronutrients from root to shoot. This hindrance is based on the fact that the Fe and Mn concentrations in plants grown in Zn-rich media are greater in the root than the shoot (Ebbs and Kochian, 1997).

Copper is considered as a micronutrient for plants (Thomas et al., 1998) and plays important role in CO_2 assimilation and ATP synthesis. Cu is also an essential component of various proteins like plastocyanin of photosynthetic system and cytochrome oxidase of respiratory electron transport chain (Demirevska-kepova et al., 2004).

The large input of Hg into the arable lands has resulted in the widespread occurrence of mercury-contamination in the entire food chain. Hg is a unique metal due to its existence in different forms e.g. HgS, Hg^{2+}, Hg° and methyl-Hg. However in agricultural soil, ionic form Hg^{2+} is predominant (Han et al., 2006). Hg released to the soil mainly remains in solid phase through adsorption onto sulfides, clay particles and organic matters. Increasing evidence has shown that Hg^{2+} can readily accumulate in higher and aquatic plants (Israr et al., 2006). High level of Hg^{2+} is strongly phytotoxic to plant cells. Toxic level of Hg^{2+} can induce visible injuries and physiological disorders in plants (Zhou et al., 2007). High level of Hg^{2+} interfere the mitochondrial activity and induces oxidative stress by triggering the generation of ROS. This leads to the disruption of biomembrane lipids and cellular metabolism in plants (Cargnelutti et al., 2006).

Pollution of biosphere with toxic metals has accelerated dramatically. Chromium (Cr) is a heavy metal that causes serious environmental contamination in soil, sediments, and groundwater (Shanker et al., 2005). The tanning industry is one of the major consumers of water and most of it is discharged as wastewater, which contains high amount of Cr (1.07–7.80 mg/l). Worldwide anthropogenic discharge of Cr in fresh water bodies has been estimated to be 3550 mt (Nriagu, 1990). Cr^{6+} is a very toxic, powerful epithelial irritant and a proven human carcinogen established by International Agency for Research on Cancer (IARC), the Environmental Protection Agency (EPA) and the World Health Organization (WHO). Toxicity of Cr has been studied in many plants. Excess of Cr causes inhibition of plant growth, chlorosis in young leaves, nutrient imbalance, wilting of tops, and root injury (Scoccianti et al., 2006). Inhibition of chlorophyll biosynthesis has also been reported in terrestrial plants (Vajpayee et al., 2000). For example, barley seedlings grown in 100 μM Cr showed 40% inhibition of growth (Skeffington et al., 1976). Toxic effects of Cr on plant growth and development include alterations in the germination process as well as in the growth of roots, stems and leaves. Hence, exposure to high level of Cr affected total dry matter production and yield of plants (Shanker et al., 2005). Cr also causes deleterious effects on plant physiological processes such as photosynthesis, water relations and mineral nutrition. Metabolic alterations by Cr exposure have also been described in plants either by a direct effect on enzymes and metabolites or by its ability to generate ROS (Shanker et al., 2005).

Lead (Pb) is one of the ubiquitously distributed most abundant toxic elements in the soil. The toxic level of Pb in soil results from disposal of municipal sewage sludge, mining and smelting activities, Pb containing paints, paper and pulp, gasoline and explosives. Pb exerts adverse effect on morphology, growth and photosynthetic processes of plants. High level of Pb also causes inhibition of enzyme activities, water imbalance, alterations in membrane permeability and disturbs mineral nutrition (Sharma and Dubey, 2005). Pb inhibits the activity of enzymes at cellular level by reacting with their sulfhydril groups. High Pb concentration also induces oxidative stress by increasing the production of ROS in plants (Reddy et al., 2005).

Arsenate (As) is an analog of phosphate (P) and competes for the same uptake carriers in the root plasmalemma of plants (Meharg and Macnair, 1992). The As tolerance has been identified in a number of plant species (Sharples et al., 2000). The As tolerance in grasses results from suppression of a high-affinity P/ As uptake system (Meharg and Macnair, 1992). This suppression reduces As influx to a level at which plant can easily detoxify it, presumably by constitutive mechanisms (Meharg, 1994). The As tolerance is achieved by a single-gene encoding for the suppressed P/As transport (Meharg andMacnair, 1992). Previously, terrestrial plants have been documented only for the presence of arsenate and arsenite (Van den Broeck et al., 1998).

Cobalt (Co) naturally occurs in the earth's crust as cobaltite [CoAsS], erythrite [$Co_3(AsO_4)_2$] and smaltite [$CoAs_2$]. Increase in Co concentration of soils can be caused by deposition from the burning of fossil fuels, wearing of Co containing alloys and spreading of sewage sludge and manure (Barceloux, 1999). Environmental risks of Co are managed through the establishment of environmental quality criteria and standards. Plants can accumulate small amount of Co from the soil. The uptake and distribution of Co in plants is species-dependent and controlled by different mechanisms (Bakkaus et al., 2005). Phytotoxicity study of Co in barley (*Hordeum vulgare* L.), oilseed rape (*Brassica napus* L.) and tomato (*Lycopersicon esculentum* L.) has recently shown the adverse effect on shoot growth and biomass (Li et al., 2009). Excess of Co restricted the concentration of Fe, chlorophyll, protein and catalase activity in leaves of cauliflower. High level of Co affected the translocation of P, S, Mn, Zn and Cu from roots to tops in cauliflower.

Excess Cu or Cr, Co significantly decreased water potential and transpiration rate. While diffusive resistance and relative water content increased in leaves of cauliflower upon exposure to excess Co (Chatterjee and Chatterjee, 2000).

Nickel (Ni) is found in natural soils at trace concentrations. Ni^{2+} concentration is increasing in certain areas by human activities (Gimeno-García et al., 1996). Ni^{2+} concentration in polluted soil may reach 20- to 30-fold (200–26,000 mg/kg) higher than the overall range (10–1000 mg/kg) found in natural soil (Izosimova, 2005). Excess of Ni^{2+} in soil causes various physiological alterations and diverse toxicity symptoms such as chlorosis and necrosis in different plant species (Rahman et al., 2005), including rice (Samantaray et al., 1997). Plants grown in high Ni^{2+} containing soil showed impairment of nutrient balance and resulted in disorder of cell membrane functions. Ni^{2+} affected the lipid composition and H-ATPase activity of the plasma membrane as reported in *Oryza sativa* shoots (Ros et al., 1992). Exposure of wheat to high level of Ni^{2+} enhanced MDA concentration (Pandolfini et al., 1992). High uptake of Ni^{2+} induced a decline in water content of dicot and monocot plant species. The decrease in water uptake is used as an indicator of the progression of Ni^{2+} toxicity in plants (Gajewska et al., 2006).

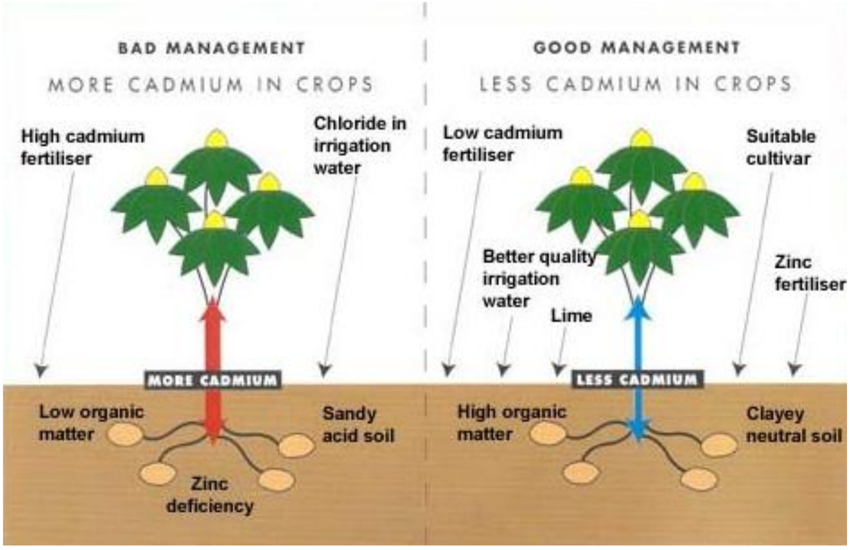
Cadmium

Cd is a natural element found in some soils, but human activities like mining and smelting release Cd into the environment at higher concentrations than normal. This can create a toxic situation for organisms living nearby if the Cd binds to organic elements and enters the food chain. It is a heavy metal that is taken up from the soil by plant roots. Cd in food is a potential threat to human health. For example, long-term accumulation in the body may lead to kidney damage.

Health authorities have set an upper limit for Cd in root, tuber and leafy vegetables. This is limit called the 'Maximum Permitted Concentration (MPC)' and is set at 0.1 mg/ kg of fresh weight.

Sources of cadmium

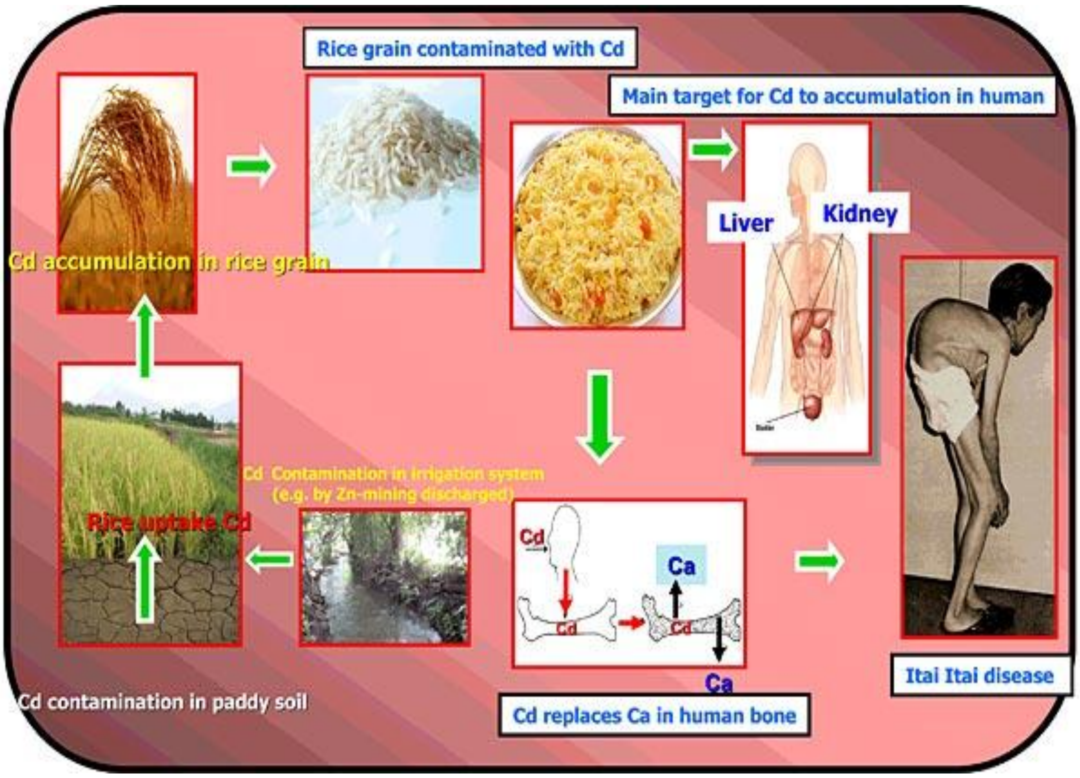
Cd occurs at very low levels. Cd is more available to plants grown in soils that are very sandy, acid and/or low in organic matter. It is present in some fertilisers and other products that are added to soils, such as: fertilisers containing P; by-product gypsum (phosphogypsum); certain zinc additives; sewage sludge; manures and other organic wastes.



Managing cadmium in potatoes for quality produce (CSIRO 1996)

For reducing the risk of cadmium problems

Use fertilisers low in Cd. Do not over-fertilise. Add lime to acid soils (pH ($CaCl_2$) less than 6.0). Keep your soil's zinc levels up. Choose plant varieties that take up less Cd. Increase soil organic matter levels. Make sure irrigation water is of good quality.



Cadmium in the human food chain (Source: Khaokaew et al., 2011)

METALS IN THE AQUATIC ENVIRONMENT

They are bioaccumulated by organisms either passively from water or by facilitated uptake. Essential metals are maintained by binding to organic molecules at a variety of biochemical sites where they function mainly as catalysts to induce or enhance enzymatic activity. Essential metals at high concentrations can have sub-lethal toxicity effects to some organisms or lethal consequences to others. Metals at deficient concentrations can have again adverse health effects. Thus essential metals can have a double "toxic" threshold.

Evaluation of metal concentrations in biological systems

- It must take into account certain factors, such as:
  - temperature,
  - redox conditions and dissolved oxygen concentration,
  - ionic strength,
  - organic complexation,
  - concentrations of metal and ligand species that compete for uptake sites,
  - pH,
  - general physiologic behaviour, life cycle and life history.

Ecological Significance of Heavy Metal Pollution

The main goal of ecotoxicological studies is to ensure that heavy metal pollution from anthropogenic pollution do not give rise to adverse effects on living organisms. Ultimately, these studies must focus on measuring levels of pollution that may induce irreversible ecological changes to aquatic ecosystems. Biomonitoring of heavy metals and effect studies on natural populations of organisms must take into account the pollution-induced community tolerance that is expected from communities that are exposed to particular pollutants for a long time (Chapman et al., 1998). Ecotoxicological studies must take into account the synthetic organo-metallic compounds or the ones formed under environmental conditions. These organo-metallic substances, especially of Hg, Pb and Sn, might have completely different toxicological properties and can be more toxic to aquatic organisms because of their high bioaccumulation (Waldock, 1998).

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SESSION OF LECTURES

ENVIRONMENTAL, QUALITY AND SAFETY MANAGEMENT SYSTEMS IMPLEMENTATION WITH FOCUSE ON THEIR INTEGRATION

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Abstract: *An increasing number of companies have now implemented management systems like Quality Management System (QMS) in accordance with ISO 9001, Environmental Management System in accordance with ISO 14001 (EMS) and / or the Occupational Health & Safety Management System in accordance with OHSAS 18001, or other standards (ISO 22000, ISO 27000, etc.). However, these standards usually do not pay enough attention to mutual integration of implemented management systems. Authors of the paper present an approach to management system integration, as it can be considered a key aspect of more effective and sustainable management of a company. The accent is put on horizontal and vertical integration of company´s activities.*

Keywords: *Integration, management system, ISO standard, organization*.

INTRODUCTION

In their nature, unsound quality, environmental problems and a risk of injuries have a common cause - a certain degree of irregularity and randomness. These causes can be reduced by effective management systems. A system organizes and simplifies, provides with orderliness and a certain structure. Integration of systems is used in order to create synergy and increase efficiency of management.

Integrated systems represent a very effective way of creating a management system which would take into account not only the quality of products and services, but also the approach to the environment and health and safety at work. Besides that, the systematic approach secures a better orientation within the requirements given by legislature and their fulfilment, makes administration simpler and saves financial sources.

Many larger and smaller organizations with foreign capital or with the business primarily in foreign markets have now implemented the Integrated Management System (IMS) in line with international requirements which assists in managing their dominant market position at home and abroad. According to Majernik (2005), thanks to the IMS they in the immediate extent manage their losses from the poor quality of products, negative impacts on the environment, or threat of safety and health at work. At present, Dufinec (2002) assumes that the organization operating in the market cannot produce high quality, if it is not managing its losses and doesn’t consider environmental protection and safety of its employees beyond the legislative requirements of our country.

In today's difficult economic situation ensuring the success of the organization implementing the various management systems becomes more and more obvious. Among the best known and most frequently applied internationally recognized standards according to Veber (2006), Virčikova (2007), Zeleny (2006) etc. can be included:

- Quality Management System (QMS),
- Environmental Management System (EMS / EMAS),
- Occupational Health and Safety Management System (OHSAS).

The short characterization of these management systems and approaches to their implementation is presented in the next part of the paper.

CHARACTERISTICS OF THE MOST COMMONLY USED MANAGEMENT SYSTEMS

Quality Management System

In the world, there are altogether several thousands of standards for management systems of quality which are divided into categories and grow in number every year. These standards are divided according to their functions. Among the best known are:
Set of ISO standards ISO 9000 – a management system of quality. Standards 9000 consist of several norms that are interconnected and complement each other. ISO standards belong to the most famous standards of quality. It is a set of standards and suggestions together with a manual for auditing of an implemented system. Standards ISO 9000 are an acknowledged standard enabling easier and transparent organization management.

ISO 19011 – is a manual for auditing management systems, specifically for management and administration of environmental audits and audits of quality.
ISO/TS 16949 (Quality Management System developed by IATF – Itnernational Automotive Task Force, working closely with International Organization for Standardization – ISO) specifies the requests for using ISO 9001 in automotive companies and companies producing spare parts.
HACCP standards – Hazard Analysis and Critical Control Points – were developed for food-processing industry.
ISO 22000 – a standard developed by the International Organization for Standardization dealing with food safety. This is a general derivative of ISO 9000.

Environmental Management System

Environmental Management System in accordance with ISO 14001 is a part of a complex management system that includes structure, planning activities, responsibilities, practices, procedures, processes and resources for the preparation, implementation, review and maintenance of environmental policy. According to Morris (2004), Majernik (2009) etc. EMS is a part of the company's management system oriented to implementation of activities aiming to environmental protection. This means implementation (integration) of elements of environmental protection in decision-making processes and management of a company.
EMS is a management system related to environmental protection and is based on a series of ISO standards 14000. Another approach to EMS implementation is European scheme EMAS (Eco-Management and Audit Scheme).

Occupational Health and Safety Management System

Requirements of quality management system mostly in the area of working environment influence not only the employees of organization, but also public in close neighbourhood. Therefore emphasis is put on meeting requirements of safety and health protection of employees in accordance with new legislative requirements related to industrial accidents and protecting citizens living in the risk area.
The structure of OHSAS Directive is compatible with the essential elements of the legislation of most European countries and above mentioned standards ISO 14001 and ISO 9001 (Schwendt, S., Funck, D. 2002).
Similarly to the EMS the basis of the system is searching of threats and evaluation of resulting risks to employees, then underpinning all possible risks and minimizing their impact. (Matias, J. C. O., Coelho, D. A. 2004) Today, regarding our alignment with EU law, this principle is anchored in the legislation of the SR.
Control system of work security according to Virčíková (2007) is a vast system of organizational structures, procedures, processes and resources, which includes compliance with all legislation requirements.

IDENTIFICATION OF COMMON AND DIFFERENT PARTS IN ALL SYSTEMS AND THEIR STANDARDS

Standards for QMS, EMS and OHSAS have several elements in common. On the other hand, they differ in some of the basic aspects and requirements. It is possible to determine these requirements and the structure of particular standards by means of analysis of individual management systems. Then, on the basis of the analysis, it is possible to define not only the common elements but also the differences of particular systems. The three systems, the QMS, the EMS and the OHSAS, have almost 80 per cent of the parts in common.

Among these common parts may be included:

- The commitment of top management,
- Documentation and records,
- Policy,
- Planning and determining the objectives,
- Processes of the staff training,
- The communication process,
- Audits,
- Managing of discrepancies,
- Corrective and preventive action,
- Management review.

Even though the management systems have many elements in common, there are also parts by which they differ. Among these are:

- specialization of the systems in different subjects and goals,
- need for different partners,
- different degree of transferring of increased costs to customer,
- different degree of importance assigned by a particular system,
- and different emphasis to continuous improvement.

HORIZONTAL AND VERTICAL INTEGRATION OF MANAGEMENT SYSTEMS

The word „integration“ is generally understood as a connection of parts and thus creation of a whole unit, in other words: uniting, joining, association. Integration of systems is understood as a unification or interconnection of several applications. In the process of implementation of integrated management systems, it is important to be aware of the necessity of horizontal as much as of vertical integration.

Horizontal integration takes place between particular management systems. In this type of integration, it is possible to use common elements of particular standards listed in the previous part of the paper. Unification of the common elements brings cumulative advantages of integration – from this point of view, integration simply enables multiple use of an activity that has already been carried out. It is not necessary to project, implement, test, etc. something new for every new demand, because it is sufficient to use already existing solutions.

Vertical integration proceeds between management systems and the system of an organization itself. An integrated management system is implemented into its functioning management. Without a vertical integration and the connection of IMS to the existing management systems, the introduction of IMS would remain only a formal act and would not bring expected benefits.

Also in this form of integration we can make use of already operating system elements and, on their basis, build an integrated management system.

A graphical illustration of the approaches is in the Figure 1.

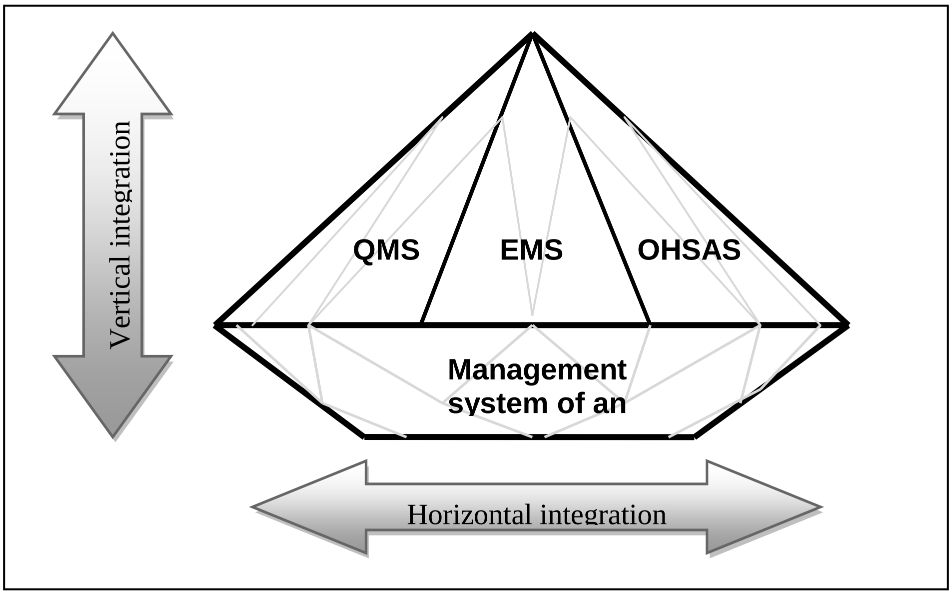

Figure 1: Integration of management systems

To illustrate the integration of management systems, we used a diamond-shaped diagram. Its parts are compact and tightly interconnected in horizontal and also vertical direction. This demonstrates the necessity of a connection between individual management systems creating thus a solid and undivided complex.

IMS is built and implanted within an organization voluntarily and is supposed to lead to the improvement of its overall profile. Therefore among the basic factors decisively influencing such activities are mainly involvement of the management of the organization and the accessibility to essential resources. In the first case, the top management must make a serious decision which may influence the image of the organization. The intention to implement the IMS, sustain and improve it must be organizationally and financially supported so that it would remain functional and fulfil all the predetermined goals.
Such a decision does not differ from any other planned intentions of an organization. In general, the decision must fulfil:

- goals – whether all the systems are to be implemented at once or successively; or whether the final goal is to certificate the systems;
- resources – human, financial, material and other resources that are required by the IMS;
- deadlines and dates – for instance a deadline for the processing of documentation, employee training, certification itself;
- responsibility – choosing a person who would be responsible for the overall administration of the system;
- schedule – is needed for the implementation of a system in accordance with the conditions of the particular organization.

Regarding this, an organization should take into account the fact that the implementation of a system requires sustaining appropriate financial and human resources. Building of the IMS and its integration into an organization is an economically demanding and time-consuming process. It involves considerable knowledge and practical experience. Therefore, the top positions in quality management, environmental or occupational and health and safety management of the organization should be assigned to managers from its top management who are capable of taking up such an important task.

BENEFITS OF MANAGEMENT SYSTEMS INTEGRATION AND OBSTACLES OF INTEGRATION

It can be very advantageous to implement and integrate management systems according to ISO 9001, ISO 14001 and OHSAS 18001 into a one functional management system, which will become a useful tool for management and ensure the prevention of all risks related to the activities of an organization. This brings many advantages but also many barriers. Among the benefits of integration can be included:

- **Avoidance of duplication and conflicts:** The requirements of the various systems shall be arranged in particular activities of the organization and then common solutions are adopted.
- **Save of time:** compared to the implementation of individual systems, IMS is not more time-consuming.
- **The benefits of synergies:** Solutions that have already been proposed, may also be used for other systems.
- **A comprehensive overview of the organization:** the activities are analyzed and improved in the integration. If contradictory requirements are revealed, they are clarified and acceptable solutions are designed for all interested parties.
- **Optimizing cost management systems:** necessary structures are commonly used, for example common documentation in one manual for the integrated management system.

Though the integration of management systems can bring a lot of advantages to the company, the barriers to the integration should be considered too. The main barriers can be divided as follows:

- External reasons:
    - Lack of standards for integrated management systems,
    - Different understanding of existing standards,
    - Lack of tools (or their non-use) in auditing / management systems evaluation.
- Internal reasons:
    - A formal approach to systems implementation,
    - Promotion of interests of different groups (e. g. quality at the expense of environment or safety),
    - Effort to satisfy certification / consulting companies (also leads to a formal approach to the implementation of IMS).

CONCLUSION

An integrated management system represents a universal and effective management tool to achieve stated objectives of manufacturing but also non-manufacturing organizations not only in the question of quality of provided products, the safety of environment and safety at work. IMS is an effective way to maximize the market value and growth of any organization. It has to support its main objectives, which are: minimization of costs, maximization of profits and gaining competitive advantage. In practice, IMS has to increase efficiency and improve the quality of business, production, information, technological and other processes and thus reduce costs of implementation of the processes. At the same time, the efficiency and quality must be achieved in the shortest time and at the lowest cost.

Vertical and horizontal integration of management systems enables the organization to use synergistic effect which is caused by mutual interconnection and unification of elements from systems, it reduces their administrative demands and saves financial resources. The goal of the paper was to point out the importance of an integration that would take place not only in a vertical direction, that is within the already existing management system of an organization and QMS and/or EMS and/or OHSAS, but also in a horizontal direction – that is the integration of newly implemented systems.

Even though such an approach of an organization towards integration is a time-consuming, staff-demanding and organizationally challenging process, a successful implementation of IMS is connected with many strategic, operating and also economic benefits not only for the organization itself, but also for other concerned parties.

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SOUND PARAMETERS AFFECTING THE PSYCHICAL COMFORT IN WORKING ENVIRONMENT

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Abstract: *This article deals with basic parameters that to a large extent influence the overall psychical comfort of men. These parameters may include the amount, loudness, color, sharpness and roughness of sound, also tonality, sensory pleasantness and subjective duration of sound. They are a very helpful tool to create, respectively adapt pleasant working environment in terms of its acoustics. In many plants there are many elements that in their actions affect the person's disturbing or even directly limiting. The current trend in acoustics and psychoacoustics aims to reduce noise and improve the facilities of psychoacoustic parameters while maintaining performance parameters facilities. Sounds from these facilities should be comfortable to humans and should not diminish his job performance.*

Keywords: *Sound parameter, comfort, psychoacoustics.*

INTRODUCTION

Psychoacoustics is the study of the relationship between physical stimuli and sensations. This field has a long history, dating back to at least the mid- 1800s and work by Gustav Fechner, who developed techniques still used in modern psychophysics. To most clinicians, psychoacoustics implies measuring intensity, frequency or temporal resolution using a nonspeech signal–that is, something unlike the signals of interest in everyday listening. [1]
Traditional psychoacoustic research has focused on the sensory impressions of an acoustic stimulus and determining the physiological structures that mediate these experiences. In comparison, the cognitive and ecological components of auditory perception have been studied somewhat less and are often treated by psychoacousticians as extraneous variables that need to be controlled. The classic technique that exemplifies this approach is signal detection theory. Essentially, the goal of signal detection theory is to separate a listener's sensitivity to a stimulus from the listener's decision criterion for responding. The goal is to separate the lower level physiological and sensory characteristics of a response from the higher order cognitive influence on deciding how to respond to the stimulus. Clearly, this is a necessary technique if we are to fully understand auditory processing. However, this type of approach alone is not sufficient. [2]
The relationship of sensory and physiological investigations to ecological and cognitive investigations should be one of synergy. Physiological discoveries of structures that are implicated in specific auditory functions give rise to specific predictions about perception and listening behavior. Thus, psychological investigations can test the limits of the relationship between the structure and the function. Conversely, discoveries in perception and listening behavior can provide direction for physiological investigations of the structures that mediate the behavior. The relationship is synergistic because advances in one area spur research in the other. [2]

Auditory perception and cognition are the result of complex physical, physiological, and cognitive factors. However, the cognitive characteristics and perception–action relationships of early psychoacoustic research were limited by the technology of the day, the dominant theoretical perspectives in psychology, and perhaps reluctance on the part of psychologists to engage in the more cumbersome physical and physiological modeling of acoustic signals and responses. Thus, influential models of auditory processing were developed using sounds that are not frequently encountered in a natural listening environment. Although this approach was useful in developing models of the function of the peripheral auditory system, it was less so in developing models of auditory cognition and behavior. However, technical innovations and paradigmatic shifts in psychology have spawned more ecologically valid investigations of complex auditory perception–action relationships and auditory cognition. These efforts complement more traditional psychoacoustic research in furthering our understanding of audition. [2]

SOUND PARAMETERS

Hearing usually takes place in the presence of complex stimuli in complex acoustic environments. The neural mechanisms and processes responsible extend beyond the peripheral auditory system and in some cases beyond the auditory system itself. For example, the auditory researcher would be hard pressed to explain things such as the McGurk effect, where visual speech can influence what is heard, or the visual effect of vocal effort on loudness using only physiological structures solely devoted to audition. It understands that the complex interaction of acoustics, physiology, sensation, perception, cognition, and behavior that is the puzzle of audition. [1]
It is appropriate to know some psychoacoustic characteristics of sound to ensure more comfortable environment in the terms of sound. These are useful to provide for well being of human much more in his working environment. Each from these characteristics is needed to assess separately.

2.1 Loudness

Loudness belongs to the category of intensity sensations. The stimulus-sensation relation cannot be constructed from the just-noticeable intensity variations directly, but has to be obtained from results of other types of measurement such as magnitude estimation. In addition to loudness, loudness level is also important. This is not only a sensation value but belongs somewhere between sensation and physical values. Besides loudness in quiet, we often hear the loudness of partially masked sounds. This loudness occurs when a masking sound is heard in addition to the sound in question. The remaining loudness ranges between a loudness of “zero”, which corresponds to the masked threshold, and the loudness of the partially masked sound is mostly much smaller than the loudness range available for unmasked sound. Partial masking can appear not only with simultaneously presented maskers but also with temporary shifted maskers. Thus the effects of partially masked loudness are both spectral and temporal. [5]
Loudness comparisons can lead to more precise results than magnitude estimations. For this reason the loudness level measure was created to characterize the loudness sensation of any sound. It was introduced in the twenties by Barkhausen, the researcher whose name was shortened to create a unit for critical-band rate, the Bark. Loudness level of a sound is the sound pressure level of a 1-kHz tone in a plane wave and frontal incident that is as loud

as the sound; its unit is “phon”. Loudness level can be measured for any sound, but best known are the loudness levels for different frequencies of pure tones. Lines which connect points of equal loudness in the hearing area are often called equal-loudness contours. [4]
The sensation that corresponds most closely to the sound intensity of the stimulus is loudness. The sensation-stimulus relation of loudness can be measured by answering the question how much louder (or softer) a sound is heard relative to a standard sound. This can be achieved by either searching for a ratio by changing the stimulus, or by judging a ratio of two sensations produced by two given stimuli. In electroacoustics and psychoacoustics, the 1-kHz tone is the most common standard sound. Instead of sound intensity, the sound intensity level is usually given. In the free-field condition, this value corresponds to the sound pressure level. The level of 40 dB of a 1-kHz tone was proposed to give the reference for loudness sensation, i.e. 1 sone.
For loudness evaluations, the simplest ratio is doubling and halving. In this case, the subject searches for the level increment that leads to a sensation that is twice as loud as that of the starting level. The average of many measurements of this kind indicates that the level of the 1-kHz tone in a plane field has to increase by 10 dB in order to enlarge the sensation of loudness by a factor of two. For example, the sound pressure level of 40 dB has to be increased to 50 dB in order to double the loudness, which then corresponds to the 2 sone. In order to plot the loudness function over the whole level range, experiments of halving and doubling the loudness at different levels have to be performed. [4]
It is often useful to be able to compare the loudness of sounds with that of a standard, reference sound. The most common reference sound is a 1000 Hz sinusoid, presented binaurally in a free field, with the sound coming from directly in front of the listener. The loudness level of a sound is defined as the intensity level of a 1000 Hz sinusoid that is equal in loudness to the sound. The unit of loudness level is the phon. Thus, the loudness level of any sound in phons is the level (in dB SPL) of the 1000 Hz sinusoid to which it sounds equal in loudness. For example, if a sound appears to be as loud as a 1000 Hz sinusoid with a level of 45 dB SPL, then the sound has a loudness level of 45 phons. To determine the loudness level of a given sound, the subject is asked to adjust the level of a 1000 Hz sinusoid until it appears to have the same loudness as that sound. The 1000 Hz sinusoid and the test sound are presented alternately rather than simultaneously. [3]

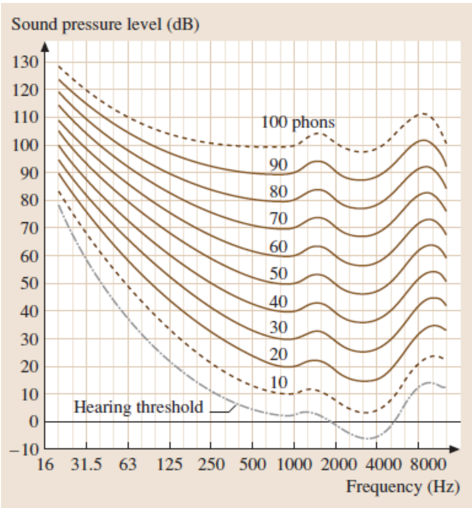

Figure 1: Equal-loudness contours for loudness levels from 10 to 100 phons for sounds presented binaurally from the frontal direction [3]

2.2 Sharpness

Sharpness is a sensation which we can consider separately, and it is possible, for example, to compare the sharpness of one sound with the sharpness of another. Sharpness can also be doubled or halved if variables are available that really change sharpness. The variability of sharpness judgements is comparable to that of loudness judgements. One of the important variables influencing the sensation of sharpness is the spectral envelope of the sound. Many comparisons have indicated that the spectral fine structure is relatively unimportant in sharpness. A noise producing a continuous spectrum, for example, has the same sharpness as a sound composed of many lines if the spectral envelopes measured in critical-band levels are the same. Sharpness increases for a level increment from 30 to 90 dB by a factor of two. This means that the dependence on level can be ignored as a first approximation, especially if the level differences are not very large. Another small effect is the dependence on bandwidth, as long as the bandwidth is smaller than a critical band. No difference in sharpness can be detected whether one tone or five tones fall within one critical band or even when a critical-band noise is used for comparison.
The most important parameters influencing sharpness are the spectral content and the centre frequency of narrow-band sounds. In order to give quantitative values, a reference point and a unit have to be defined. In Latin, the expression “acum” is used for sharp. The reference sound producing 1 acum is a narrow-band noise one critical-band wide at a centre frequency of 1 kHz having a level of 60 dB.
It is helpful in developing a model of sharpness to treat sharpness as being independent of the fine structure of the spectrum; the overall spectral envelope is the main factor influencing sharpness. [4]

2.3 Sensory pleasantness

Sensory pleasantness is a more complex sensation that is influenced by elementary auditory sensations such as roughness, sharpness, tonality, and loudness. Because of these influences, which make it almost impossible to extract sensory pleasantness as a single elementary sensation, it is necessary to measure the dependence of this sensation in relative values, using the techniques of magnitude estimation with an anchor.

The dependence of sensory pleasantness on sharpness was measured using sinusoidal tones, narrow-band noise of 30-Hz bandwidth and band-pass noise with a 1-kHz bandwidth as a function of centre frequency. The data show some scatter. The relationships between sensory pleasantness and other sensations are given as curves in Fig. 2. Figure 2a shows pleasantness against relative roughness and Fig. 2b pleasantness against sharpness for the three sounds. It becomes clear that sensory pleasantness decreases with increasing sharpness. Pure tones already show the largest sensory pleasantness, while the band-pass noise seems to be a sound with low sensory pleasantness.
Similar to the dependence on sharpness, sensory pleasantness depends on roughness, although the dependence is not as strong. Because the data are again measured using the method of magnitude estimation with an anchor, only relative values can be given. [4]

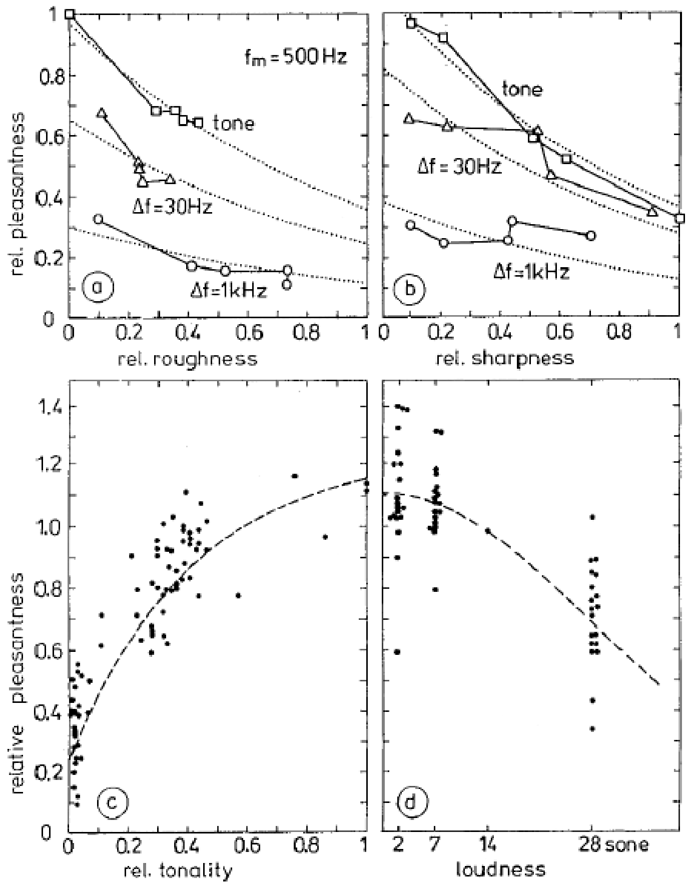

Figure 2: Relative pleasantness as a function of relative roughness with bandwidth as the parameter in (a); as a function of relative sharpness in (b); as a function of relative tonality in (c) and as a function of loudness in (d) [4]

2.4 Fluctuation strength

Modulated sounds elicit two different kinds of hearing sensations: at low modulation frequencies up to a modulation frequency of about 20 Hz, the hearing sensation of **fluctuation strength** is produced. At higher modulation frequencies, the hearing sensation of roughness occurs. For modulation frequencies around 20 Hz, there is a transition between the hearing sensation of fluctuation strength and that of roughness. It is a smooth transition rather than a strong border that exists between the two sensations.
Figure 3 shows the dependence of the fluctuation strength of amplitude modulated broad-band noise and amplitude-modulated pure tones on both the modulation depth and the modulation factor. In each panel, the fluctuation strength is normalized with respect to the corresponding maximum value on the left ordinate scales and given in absolute values on the right ordinate scales. According to the results displayed in Figure 3, fluctuation strength is zero until a modulation depth of about 3 dB, after which it increases approximately linearly with the logarithm of modulation depth. To produce the maximum fluctuation strength of either sound, a modulation depth of at least 30 dB (modulation factor 94%) is necessary. Above that modulation depth, fluctuation strength remains constant at its maximal value.

The large fluctuation strength of amplitude-modulated broad-band noise and frequency-modulated pure tones with large frequency deviation (sounds 2 and 1) can be related to the fact that excitation varies to a large extent along the critical-band rate scale. Therefore, it can be postulated that fluctuation strength is summed up across critical bands. [4]

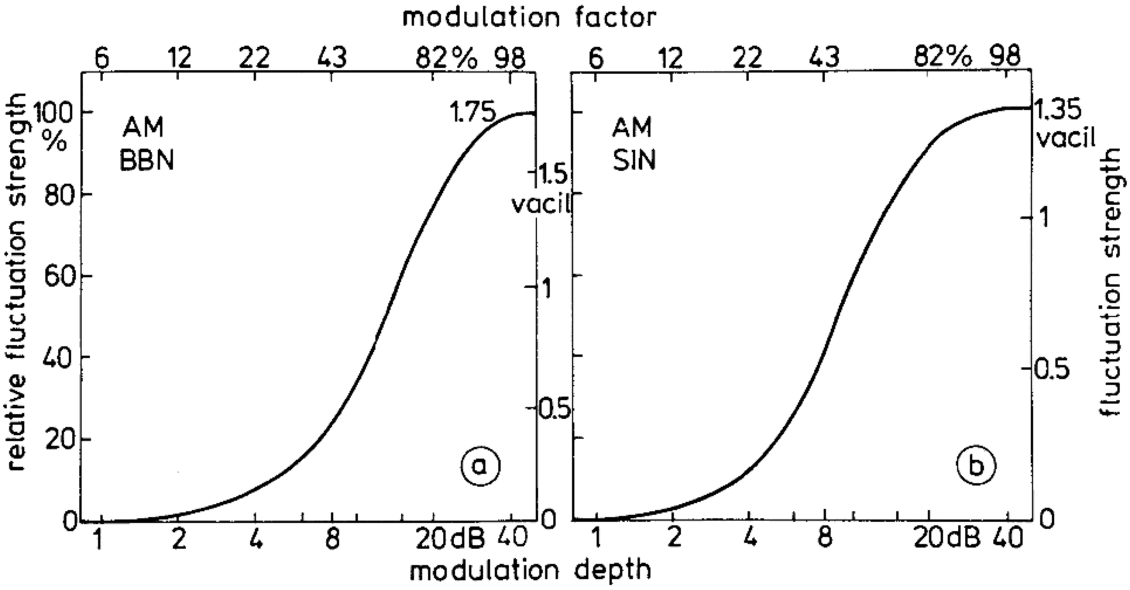

Figure 3: Fluctuation strength of two amplitude-modulated sounds as a function of modulation depth (or modulation factor): a) Amplitude-modulated broadband noise of 60-dB SPL and 4-Hz modulation frequency; b) amplitude-modulated 1-kHz tone of 70-dB SPL and 4-Hz modulation frequency [4]

2.5 Roughness

Using a 100% amplitude-modulated 1-kHz tone and increasing the modulation frequency from low to high values, three different areas of sensation are traversed. At very low modulation frequencies the loudness changes slowly up and down. The sensation produced is that of fluctuation. This sensation reaches a maximum at modulation frequencies near 4 Hz and decreases for higher modulation frequencies. At about 15 Hz, another type of sensation, **roughness**, starts to increase. It reaches its maximum near modulation frequencies of 70 Hz and decreases at higher modulation frequencies. As roughness decreases, the sensation of hearing three separately audible tones increases. This sensation is small for modulation frequencies near 150 Hz; it increases strongly, however, for larger modulation frequencies. This behavior indicates that roughness is created by the relatively quick changes produced by modulation frequencies in the region between about 15 to 300 Hz. There is no need for exact periodical modulation, but the spectrum of the modulating function has to be between 15 and 300 Hz in order to produce roughness. For this reason, most narrow-band noises sound rough even though there is no periodical change in envelope or frequency. Roughness is again a sensation which we can consider while ignoring other sensations.
In order to describe roughness quantitatively, a reference value must be defined. In Latin, the word “asper” characterizes what we call “rough”. To define the roughness of 1 asper, we have chosen the 60-dB, 1-kHz tone that is 100% modulated in amplitude at a modulation

frequency of 70 Hz. Three parameters are important in determining roughness. For amplitude modulation, the important parameters are the degree of modulation and modulation frequency. For frequency modulation, it is the frequency modulation index and modulation frequency. [4]

2.6 Subjective duration

Subjective duration is not drastically different from objective duration if the durations of long-lasting sound bursts are compared. Therefore, it is often assumed that subjective duration and objective duration are almost equal. This is not so, however, when the duration of sound bursts is compared with the duration of sound pauses. In this case, drastic differences appear which indicate the need to consider subjective duration as a separate sensation. [4]

The scale of subjective duration can be quantified by fixing a reference value and a unit. We have chosen as the unit the “dura” and have determined that a 1-kHz tone of 60 dB sound pressure level and the 1 s physical duration, produces a subjective duration of 1 dura. By halving and doubling, we can produce the relationship between subjective duration and physical duration for 1-kHz tone bursts. The result is plotted in Figure 4 in double logarithmic scales. The subjective duration, *D*, is the ordinate, and physical duration, *Ti*, is the abscissa. The reference point is marked by an open circle. Proportionality between the two values would be indicated by the broken 45◦ line.

This proportionality is effective over a wide range, starting at large durations of 3 s down to duration of about 100 ms. Below that physical duration, subjective duration deviates from this proportionality with the tendency that subjective duration decreases less than physical duration. However, these results may be influenced by the fact that reducing the duration of the 1-kHz tone produces a different spectrum. Therefore, white noise was used to produce shorter sound bursts without changing the spectrum. For large durations, white-noise bursts show the same proportionality between physical and subjective duration as found for 1-kHz tones. The physical duration of white noise can be reduced to 0.3 ms without much influence on the spectral shape. The results in this short duration area confirmed the tendency of 1-kHz tones to show little difference in subjective durations when physical duration is changed from 1ms to 0.5 ms. From these measurements, it can be concluded that the effect shown in Figure 4 is not a side effect based on the spectral broadening of the shorter 1-kHz tone bursts, but an effect that is based on the behaviour of human hearing. This means that one cannot expect subjective duration and objective duration to be equal for durations shorter than 100 ms. [4]

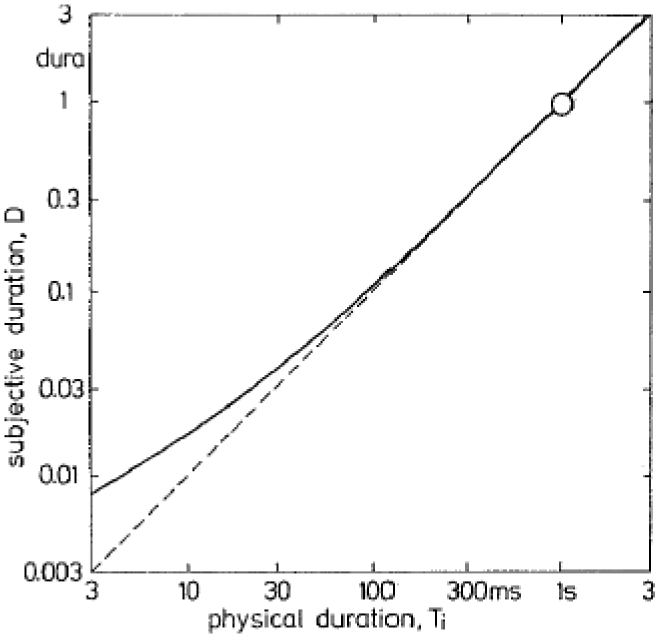

Figure 4: Subjective duration as a function of the physical duration of 1-kHz tones at 60 dB SPL (solid line). The broken line indicates equality of physical and subjective duration. The open circle marks the standard sound producing a subjective duration of 1 dura [4]

CONCLUSION

In assessing the impact of noise on man in his working environment is important first to know the source of noise. Consequently, it is necessary to characterize the individual parameters of the noise on the basis of which are the effect of noise on humans specified. A very important parameter is just the loudness, which to a large extent affects the person's work performance in the working environment. Note that the subjective loudness of a sound is not directly proportional to its loudness level in phons. For example, a sound with a loudness level of 80 phons sounds much more than twice as loud as a sound with a loudness level of 40 phons.
Next equally important parameter is sharpness of the sound which considerably affects the person's work comfort. We must not forget the fluctuation strength, which is particularly important parameter in the modulated frequency which varies widely from 3 dB. In summary, it can be seen that sensory pleasantness depends mostly on sharpness.
The influence of roughness is somewhat smaller and is similar to that of tonality. Loudness, however, influences sensory pleasantness only for values that are larger than the normal loudness of communication between two people in quiet. When we talk about duration, we normally think of objective duration, i.e. physical duration measured in seconds, milliseconds or minutes. This is so, although we often check durations by listening to them in music, for example, or by giving a talk, where a short silence can add emphasis. If such durations can be measured by listening, they cannot be objective durations but must be subjective because they correspond to sensations.

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WASTE MANAGEMENT AND SANITATION IN CITY OF OUIDAH (BENIN, WEST AFRICA)

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Abstract: *The multiplicity of the activities generated by the increase in population creates a persistent insalubrity in the town of Ouidah. This study indexes the regenerating activities of waste and analyzes their impacts on the city. The information retrieval, the observations of ground are carried out on the state of healthiness of the 22 districts of the four districts of the city and of the investigations by survey are organized in 218 households chosen randomly. It results from it that 68 tons of waste solid domestic and economic are produced per day in the city; 40% of the people interviewed are subscribed with the services of pre-collection and deposit the refuse in the dustbin. The remainder throws them in nature. As for waste water, 58.60% of the people interviewed pour them in the more or less covered family sumps and the remainder the shift in the courses of house or the gutters. To such hazardous management, it belongs to the degradation of the water resources and the propagation of the waterborne diseases such as the diarrhea, the dysentery, the gastroenteritis and the parasitosis. It would be interesting that the communal authorities in dialog with the population proceed to healthiness by developing the strategy of management integrated of waste in the town of Ouidah.*

Keywords: *Benin, Ouidah city, population growth, hazardous waste production, water resources pollution.*

1. Introduction

The management of waste often does not follow the rhythm of their production in the majority of the countries of the world. It is a problem to which especially the Third World countries face. It is persistent in the cities with unverifiable population growth of the countries with limited means. This problem is characterized by the proliferation of the refuse in the streets, by the development of the wild dumps on empty spaces or in the neighborhoods of the dwellings; proliferation of the food remainders coming from the rejection of waste water in the courses of houses and the streets; a bad hygiene of the framework of life; stagnation of rain water and waste water in the networks of drainage of rain water,… Such kind of life negatively influences the soft water resources, the living environment, and human body and indirectly affects the economic development of the country in question. In 2002, WHO (the World Health Organization) estimated at 2,6 billion is 42% the world population which do not have access to an adequate cleansing and 1,1 billion individuals, that is to say the 17% world population which did not have access to drinking water. This disastrous report brought UNO (United Nations) worked out OMD (Objective Millenium for the Development) within the framework of the improvement of the conditions of human life (Adoko, 2012).
The Benin, and in particular the town of Ouidah, in the commune of Ouidah, under the influence of the population growth is confronted with waste management increasingly producted. Indeed, Ouidah city undergoes the proliferation of waste, the development of the

wild dumps. This study characterizes produced waste, analyzes the modes of their management and shows their influences on the water resources and on health of the urban population of Ouidah.
Ouidah city, object of this study, is located between 2°4' and 2°17' longitude Is and 6°15' and 6°22' latitude Northern. It is a coastal town of the southernmost area of Benign being on the edge of the plate of Allada. It is limited to the south by the districts of Djègbadji and Houakpé Daho, with north by the district of Savi and the commune of Large-Popo, in the east by the districts of Pahou and Avlékété and with the west by the commune of Kpomassè (figure 1).

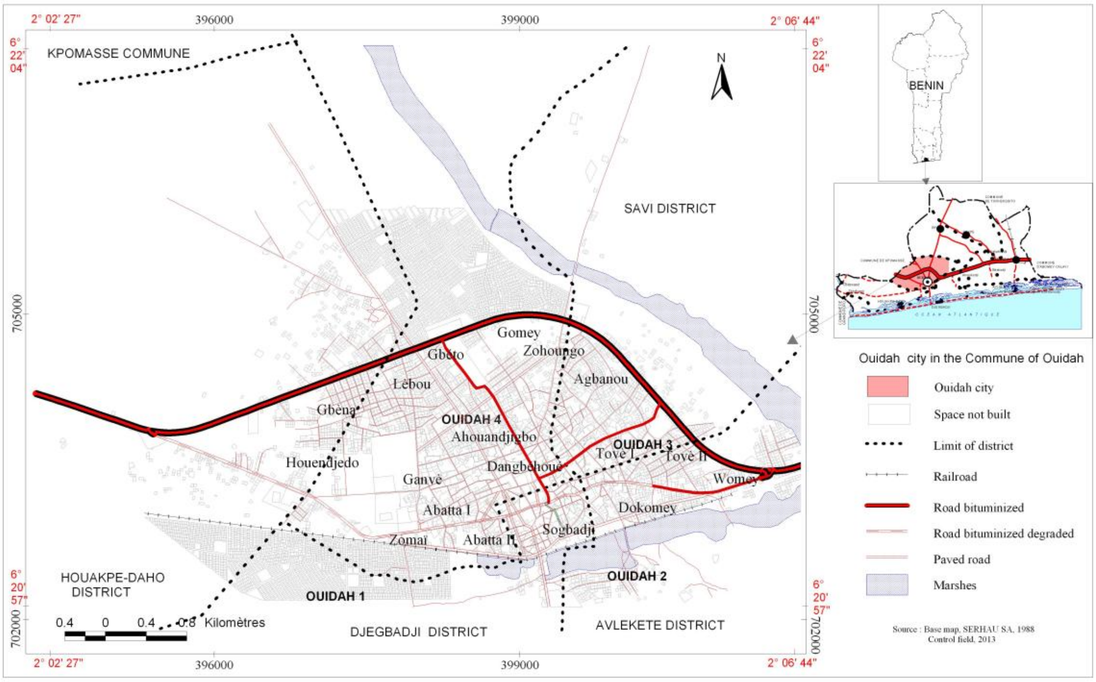

Figure 1 : Geographical location of the town of Ouidah

Figure 1 presents the town of Ouidah which extends on 39.32 km2 and sheltered 37647 inhabitants in 2002 (INSAE, op. cit.). The city was spread out over plate far from broken, made up of argilo-sandy red grounds whose content of clay varies with the depth. The permeability of these grounds is in general average. The highest altitude is of 22 m and lowest is of 3 m on average. The slopes vary from 1 to 8% with slopes towards the west, is and southern (Agbo, 1984, Odoulami, 1994).

The city is in the subequatorial zone with two rainy seasons of unequal duration which go from March at July for the great season and from September to November for the small season and two dry seasons also of unequal duration which go from November at March for the great dry season and from July to September for the small season. The rains vary from 950 to 1150 mm between May and October during the year.
The annual average temperature is of 27°C. The wind suffers from the south or south-west with an high speed to 20 km/h during the year (Boko, 1988 and SMN, 1991). It should be noted that this city is subdivided in 4 urban districts including whole 22 districts of 9467

households in 2002 (INSAE, op. cit.). These different characteristics of Ouidah city support the development of the socio-economic activities which are at the origin of the bad management of waste. The analysis of the factors intervening in the management of waste of Ouidah city requires a methodology.

2. Data and methods of research
2.1. Data used

The data used in this study are at the same time qualitative and quantitative. They are primarily made up of the variables which made it possible to analyze the influences of the management of the waste produced in the town of Ouidah. It acts:
- demographic statistics were collected at the National institute of the Statistics and the Economy (INSAE) and in the centers and services of documentation (SERHAU-Sa, DGAT,);
- heights moreover were collected with the Service of Meteorology Nationnal (SMN) of the Agency for Safety and the Aerial navigation in Africa and in Madagascar (' ASECNA) over the period 1971 to 2008
- data on the evacuation of waste which was collected near the structures of collecting of waste in Ouidah city.

These data are supplemented by observations of the state of healthiness in the 22 districts of the 4 urban districts of Ouidah and the investigations by questionnaires, interview guides are made in 218 households of the city (INSAE, 2004). In the same way, 20 people resources made up of the local authorities, the agents of the town hall of Ouidah and ONG of collection of the household refuse are interviewed. The expressive images on the state of cleansing of the city were taken at certain places of the city.
These collected data are treated and analyzed under Windows 7 (Word and Excel) and certain results are presented in the form of tables and of graphs.

3. Results and discussions
3.1. Evolution of the population and production of waste in the town of Ouidah

The production of waste in the town of Ouidah is related to several factors of which in particular demographic dynamics and the activities which come out from it.
The population of the town of Ouidah increased these thirty last years and generates the production of waste in significant amount (table 1).

Table I: Evolution of the population of the town of Ouidah of 1972 to 2002

Year	1972	1979	1992	2002
Population	16107	25342	32454	37647

Source: (Agbo, 1984; INSAE, 2002).

Table I shows the evolution of the population on thirty recent years. From 1972 to 2002, the population of the town of Ouidah increased considerably. This growth is especially remarkable in 1979 and 1992.This growth of the population continued in 2002 but it is less remarkable than in 1992. This fact is shown through in growth rates of the population of the commune of Ouidah which are respectively of 1.88% between 1979 and 1992 and of 1.74% between 1992 and 2002. A light deceleration is thus noted in the growth of the urban population of Ouidah commune which would be caused by the emigration for reason of under employment towards the communes with statute particular.

With the rate of increase in 1.74% between 1992 and 2002, this population would have passed to 38787 inhabitants in 2012. Such an increase in the population induces necessarily the multiplicity of the generating activities of waste. Those are developed at the sides of the agricultural activities in regression for reasons of the human occupation, impoverishment or sale of the cultivable grounds. These producing activities of waste in the city are several categories.

The category of the trade and transport which occupy more half of the active population of the town of Ouidah organizes around the market `' Kpassè". The commercial activities those proceed there product enormous waste. For this waste, it is necessary to add those from the activities of exchanges and transformations, waste coming from the sweeping of the markets, the public highways, the hospitals, the offices, the establishments and small companies, of tourism.

The other category of waste is that coming from the artisanal activities. They are waste resulting from the agro-alimentary transformation (groundnut, corn, manioc, etc) and manufacture of the art objects. It is necessary to include in this category, the residues of the raw materials used or transforms, the rotting products, the waste water, etc. of these activities.

Lastly, the category of domestic waste results from the food products, packing, sweeping, waste water product day-to-day in the households of the town of Ouidah.

The satisfaction of the human needs by the exploitation of natural resources and even artificial resources without conscience induces negligence or the damage to living environment. Thus are perceived the insalubrities in the town of Ouidah. The fundamental cause of those insalubrities lies in the management of waste derived from these resources used or transformed.

3.2. Management of the waste produced in the town of Ouidah

The waste produced in the town of Ouidah is several kinds with knowing solid waste and liquid waste. These two types of waste are differently managed in the city.

3.2.1. Management styles of solid waste in the town of Ouidah

As underlined, the use or the transformation of the natural or artificial resources supports the creation of a multitude of socio-economic activities which generate waste. After the observations on the state of healthiness of the urban districts of Ouidah, which is remarkable is the intermingling and the accumulation of waste coming from the socio-economic activities of the city without presorting. This waste is in proliferation or poured in the streets, the gutters, the courses of houses, along the fences of the dwellings, the hollows, on the empty pieces (photos 1, 2, 3).

These three photos show piled up waste of commercial and domestic origin or in proliferation in the town of Ouidah. The accumulation of waste near a well can be a source of contamination of the water which can affect the health of the consumers indirectly. In the same way, the refuse strewing the fences with house and the place of commercial exchanges is sources of infections for those which are exposed there. It should be noted that these discharges or wild dumps of refuse are multiple in the town of Ouidah. Great quantities of waste are thus produced in the city.

Photo 1: A heap of waste the various ones being next to a well with lid of fortune to the district Wilifanmè (3rd urban district of Ouidah). Catch of sight by Adoko Ines, 2011

Photo 2: A wild dump several kinds of rejections in the district Gomey (3rd district of Ouidah). Catch of sight by Adoko Ines, 2011

Photo 3: A heap of refuse to the back of a group of sale speople in the market `' Kpassè" in the 3rd district of Ouidah). Catch of sight by Adoko Ines, 2011

According to the collective of NGO intervening in the pre-collection in Ouidah, 68 tons of waste are produced the every day in the city and are differently managed. The evacuation of solid waste is made several manners in the town of Ouidah: Part of waste is collected by the agents of structures of pre-collection, while the other is directly managed by the population (table I).

Table I: Management methods of the domestic solid in Ouidah city

Management methods	Effective	Percentage (%)
Dump	109	50,70
NGO	86	40
Others	20	9,30
Total	215	100

Source: Adoko Inès, 2011

Table I shows that more than 50% of the interviewed households pour their refuse on the wild dumps and 40% have their refuse removed by the agents of NGO of pre-collection. The remainder is piled up or poured in the courses of house, the gutters, beside the houses, on

the public highways, on the empty pieces, burned or hides. Thus, 60% of the interviewed households manage in an uncontrolled way waste which they produce in the city. This report shows that the danger which arises from the bad management of waste is not well perceived by the households of the town of Ouidah. However, a study carried out in 2006 in the city revealed that 92% of the households understood the fatal consequences of insalubrities on the human health but 3850 households only out of the total of 9000 households are subscribed in NGO of pre-collection to a variable tariff between 500 and 5000 FCFA (CISV, 2006). This paradox could be explained by the precariousness of the incomes of households which can be a source of affections leading to the lack of hygiene from where growing insalubrities of the city emerges.
With regard to the removal of the dustbins among subscribers, the same report is observed. The household refuse are often stored in dustbins not conforms to the rules of hygiene such as the containers, the baskets, the buckets, etc users whose majority are not protected (photo 4).

Photo 4: Basket and plastic being used as dustbins in the district Dangbéhouè (district 1, Ouidah). Catch of sight Adoko Enès, June 2011

The photo 4 shows dustbins user overflowed of refuse and not protected in the Dangbéhouè district. Indeed, the majority of the dustbins are often filled of mixture of waste bio degradable and non bio degradable and without protection. This kind of storage carries damage to the environment life and the human health. Because such that the two dustbins of photo 4 are presented, the vegetable matters, under the effect of the wind force, can fly away easily to encumber the ground and to create in the ambient conditions insalubrities. Such a thing is visible in the bottom of these two dustbins. An insufficient popularization of the code of hygiene in force to Benin and the bad habits can explain this kind of management **(Ministère de la Santé publique,** 1987). It is also important to examine the management styles of waste water produced in the households.

3.2.2. Management styles of domestic waste water in the town of Ouidah

The evacuation of waste water suffers much from insufficiencies. These insufficiencies are related to the absence of networks of cleansing. Apart from the structures of draining of septic tank, the structures of pre-collection of waste water are also non-existent.
However, the sumps are used by certain more or less easy households for the evacuation of waste water. But of other households pour their waste water in the courses of house, on the public routes, in the gutters, (table II).

Table II: Methods of domestic wastewater management according to the households

	Methods of domestic wastewater drainage			
	Sumps	Gutters	Routes	Total
Effective	126	42	45	215
%	58,60	19,53	20,93	100

Source: Adoko Inès, 2011

The table II shows the modes of evacuation of waste water of use in the town of Ouidah. More than 58% of the households of investigation their domestic waste water in the sumps of the concessions evacuates. This rate shows that the sump is the mode of evacuation of waste water more used in the town of Ouidah. But they, for the majority, are careless protected (photos 5 and 6).

Photo 5: A functional sump but partially protected in district 1 of the town of Ouidah. Catch of sight Adoko E., June 2012

Photo 6: A section of rain water crest gate playing the part of waste water collector of a dwelling starting from a outfall in the district Tovè1 (district 3, Ouidah). Catch of sight Adoko E., June 2012

The photos 4 and 5 show a sump with cover partly deteriorated and rain water gutter being used as collector of water of a house. The degradation of the cover of the sump would be related to the proportioning of cement and badly made sand and which were useful in the masonry of the sump and with the bad dimensioning of the work. This defect could come from the low level of technicality of the elected manufacturer and also of the low level of knowledge of the rules of hygiene and average the techniques available to the commander. This device is thus not adapted to a good cleansing of this house. In the same way, the use of a drain pipe of rain water in the form of sewer is not in conformity with the rules of hygiene. The sedimentation of the residues of food and others generates the roughness of the funds of the crest gates of rain water and causes the stagnation of rain water and the floods in certain districts of the city.

In addition, the sedimentation of the residues of waste water is followed putrefaction supported by the aerobic conditions and the temperature of the medium. The latter varies between 24°C and 30°C during the rainy season and enters 23°C and 33°C in dry season (Boko, op. cit.) in the town of Ouidah. This environment ambiance accelerates especially the decomposition of the refuses bio degradable of waste water poured in the cracks of the streets, houses, of the marshy places. It releases some from bad smell, the proliferation of the larvae then pathogenic insects and mosquitoes, germs and harmful toxic inorganic pollutants at the human organism. It should be noted that always under the heating effects, the same processes proceed in the solid heaps of waste bio degradable. In this solid waste, in addition to the above mentioned pollutants, there is the development of the rodents (cockroaches, rats …) who are released in nature.
The majority of these toxic pollutants are mobilized and pulled by the streaming and the infiltration of rain water. Indeed, the town of Ouidah enjoys two rainy seasons and two dry.
A great rainy season which proceed between March and July with a concentration of rains over June and another of short duration which has place between September and October with a concentration of rains over October. The other months are thus dry. It is during these wet seasons that are made the processes of mobilization, infiltration or streaming of the contaminants of waste water and the refuse produced in the town of Ouidah. These processes are facilitated by the slopes in general weak of the plate and by the sandy argillaceous structures of the grounds of the city. The infiltration and the streaming of these toxic contaminants degrade the quality of the water resources used of the town of Ouidah. However, the majority of the population of Ouidah reaches these water resources by the traditional wells often more or less protected. Still 30.23% of the interviewed households still consume water of well in the town of Ouidah and are exposed to the diseases of hydrous origin.
Indeed, the diseases related to the ingestion of the water of quality such as the gastroenteritis, the diarrheas, the typhoid fever, etc were announced by the interviewed households. Other diseases related on the insufficiency of hygiene and the cleansing such as the paludism, the affections dermatological, infested them respiratory, etc are also announced. These diseases which prevail in the town of Ouidah prevent the patients from being occupied with the economic activities of the city. This situation is not without negative consequence on the urban development of Ouidah.
The insufficiency noticed in the management of waste and the cleansing of the town of Ouidah is not specific to the town of Ouidah. Monqid (2008) showed that the city of Cairo is in the crisis related to the upheavals of the traditional behaviors of management of waste. It results from this the proliferation from the heaps of waste in the streets and beside the dwellings. In France also, Kah (1999) showed the difficulties which emerged in the integrated management of waste. In the same way, Odoulami (2013) showed that the production of waste in the town of Cotonou to Benin exceeds the capacity of removal of waste of the communal authorities in the town of Cotonou to the benign one. She noticed that the techniques of recycles and of valorization of waste are adopted in the management of waste by the population and the municipal authorities of the town of Cotonou.
Such a technique is also adopted in the town of Ouidah. Indeed, the structures of management created spontaneously and mobilized developed with international actors and nationals in collaboration with the town hall of Ouidah of the activities of sorting and valorization of waste on the points of regroupings of waste. These activities regulated some problem of unemployment, improved the living environment and reported to the town hall of the substantial profits (CISV, 2008). The recycling of the users objects on the points of

regrouping and their resale is also organized within the population. However, much remains to be made.
It would be necessary that the communal authorities imply and promote again the sector of the management of waste of the town of Ouidah taking into account the prerogatives which are conferred to them by the law n°97-029 of bearing January 15th, 1999 organization of the communes in Republic of Benin which stipulates in its article 93 that “the commune with the load of the solid the waste collection and processing others that the industrial waste”. For the moment, the actions carried out by the municipality are primarily the support for the cleaning of the public highways and the provision of rolling stock for the displacement of waste pre collected (CISV, COp cit.).
It is desirable that the town hall of Ouidah still carries out popularization then with the application of the existing texts on hygiene and the cleansing in force to the Benin. Indeed, articles 2, 3, 4 and 6 of the code of hygiene of Benin prohibit the deposit or the discharge of rubbish, waste water in the streets, on the public highways,… or the hiding of the remainders of animals and refuse on the public highways, etc for the safeguarding of the water resources, the environment in general and in particular the health of the urban population of Ouidah.

4. Conclusion

The increase in the population of the town of Ouidah involved a multiplicity of generating activities of solid and liquid waste. In spite of, the removal of domestic solid waste of the households subscribed by structures of pre collection, solid waste is in proliferation, is found on wild dumps, on the public highways, poured on the empty pieces or in gutters, etc. As for waste water, they are evacuated in little maintained sumps, works of drainage of rain water, on the public highways, etc. This waste thus badly managed, create the insalubrities of the town of Ouidah and constitute a source of deterioration of the quality of the water resources, environment in general and affect pubic health of the town of Ouidah. The strategy of management integrated of solid waste was developed. But, it needs the implication and the relaunching, the popularization and the application of the texts on hygiene and the cleansing by the communal authorities for the cleanliness of the town of Ouidah.

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ROLE OF THE CHIRALITY IN THE ENVIRONMENTAL SCIENCE

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Abstract: *The enantiomer pairs can show different biological activity and environmental behavior in spite of their very similar structures. Recently, several agrochemicals are commercialized as pure (R) or (S) isomers, to decrease the burden of environment. The decompositions of members of the enantiomer pairs can alter with the decomposition media (species organs) too. The enantiomer ratio of a compound can show the origin (time, media, and producer) of the pollution. The chiral selective analyses are important and rather hard task for the environmental protections.*

Keywords: *chiral molecules, chiral selective degradations, chiral selective analysis*

1 INTRODUCTION

The chirality plays important role in the environmental science, because several pesticide effects, degradation processes and analytical methods are chiral selective [1, 2].

The chiral molecules have asymmetry in their structures [3]. Those chiral molecules, which are mirror image of each others, are called enantiomeric pairs. The recent assignations of isomers are *(R)* and *(S)*, but their old assignations (+) and (-) or *(L)* and *(D)* are also used (e.g. amino acids and sugars).

Overwhelming part of molecules are asymmetric in the nature, therefore the chirality plays important role in the reactions of the environment. The compounds of nature (sugars, amino acids, pheromones, DNS etc.) frequently have only one enantiomer from their enantiomer pairs. The amino acids of mammalian proteins contain only L- amino acids. If a meat sample contains D-amino acids, a bacterial infection or intensive heat shock can be concluded [4].

The enantiomer pairs can show different biological activity and environmental behavior in spite of their very similar structures. They can differ from each other in their actions metabolisms and decomposition rate and way [5].

2 DISCUSSION

Recently, several agrochemicals are commercialized as pure (*R*) or (*S*) isomers, to decrease the burden of the environment. The aryloxy-propionic acids are selective and broadly used herbicides. Mostly their (*R*) isomers are responsible for their herbicidal activity, but both isomers show unwanted side effects. Recently, they are commercialized as pure (*R*) isomers [6]. The importance of the enantiomer pure products is demonstrated that marine organism can degrade only the (*R*) isomers of aryloxy-propionic acids [7]. The requirement of enantiomeric pure pesticides makes necessary of their chiral selective analysis (Figure. 1). The figure 1 shows that the used column can enantiomerically separate the aryloxy-propionic acid, which has chiral centers from these types of herbicides.

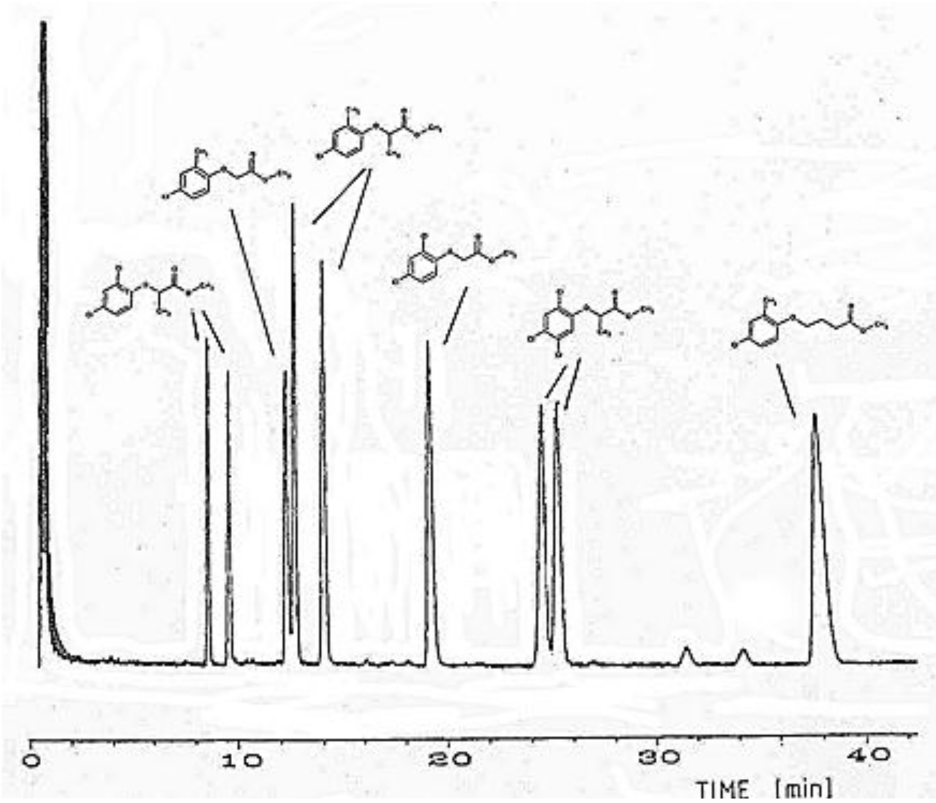

Figure 1: The chiral selective gas chromatographic analysis of methylated derivatives of aryloxy acid herbicides. Conditions: column, 12 m x 0.25 mm I.D: FSOT; stationary phase, ChirasilDEX (permethyl β-cyclodextrin containing silicone polymer; film thickness, 0.15 µm; carrier, H2; column temperature, 115° C; detector, FID.

The chloroacetanilide compounds are pre emergency grass herbicide, which are frequently used in maze cultivations. Their (*S*) isomers show much higher activity than their (*R*) isomers. Metolachclor are also commercialized in enriched (*S*) isomer forms [8]. Single isomeric Deltamethrin (α*S*, 1*R*-cis), a pyretrhoid insecticide has gained big popularity, because its high activity connects with relatively low burden of environment.

The decomposition rate of enantiomers can differ from each others. The enantiomer selective degradation shows a biological degradation process. On the other hand, a non-enantiomer selective degradation is the sign of physico-chemical degradation (e.g. photo decomposition, acidic hydrolysis). The time of the a *o,p*-DDT pollution can calculate from enantiomer ratio of remaining *o,p*-DDT. Namely, the age of the pollution correlates with the deviation of enantiomeric ratio from 1:1.

The source of pollution can be determined with establishment of its enantiomer ratio. The enantiomer ratios of chlordane significantly shift from 1: 1 ratio according to the depth of sediments of rivers and lakes [9]. The depths of pollutions correlate with the age of deposited layer. If an air sample shows significant enantiomer excess of one isomer of α-HCH, the pollution is the result of revolatilization from the water [10].

It is important to note that some factors (e.g. soil type, pH climate) influence of the enantiomer ratios of pollutions. The climate change influences the soil biota, which effects the enantiomer selective degradations [11].

The pheromones play a key role in the communications of insects. Their effects are rather selective toward to different species; therefore they can be applied as very selective agents (e.g. bee safe) in the insect controls. Overwhelming parts of the pheromones are also chiral. The optical isomers can show totally different effects. For example the olean is the the sex pheromone of the olive fruit fly. Its (R)-isomer is active against the males and the (S)-isomer is active against the females [12].

The enantiomeric ratio can refer the place of decomposition. The degradation of (**+**) enantiomers of α-HCH is favored, therefore the remaining α-HCH pollution are enriched in the (-) isomer in Baltic Sea originated samples [13]. On the other hand, the microbiological degradation prefers the (-) isomers in the British bank of North Sea [14].

The decompositions of enantiomers can alter with the decomposition media (species, organs) too. For example, the common Eider ducks selectively metabolize the (-) isomer of α-HCH [15]. However, the samples from the liver of terrestrial Roe–deer show the opposite enantiomer ratio then the liver of the common Eider ducks [16]. It is interesting to note, only the (+)-α-HCH can pass the blood-brain barrier in several tested animal species [17]. The (*R*) isomer of 2,4-DP degrades well by marine microorganism, but the (*S*) enantiomer of 2,4-DP degraded very small extent [7]. This phenomenon caused a significant accumulation of (*S*) enantiomer of 2,4-DP marine environment. The chiral illicit drug, methamphetamine shows also enantiomer selective degradation with S isomer preference in the natural aquatic media [17].

The anaerobic treatment of sewage sludge produces enantiomer selective degradation of α-HCH with bigger decomposition rate of (+)-α-HCH. One of the most popular human drugs, the Ibuprofen is also chiral. The enantiomer ratio of the excreted Ibuprofen is 19 with (*S*) majority. This high enantiomer ratio decreases to 5.5-8 values in effluent of sewage works, showing the higher microbial degradation rate of (*R*) enantiomer during sewage treatment [18].

The chiral selective analyses are also important in the environmental protection. High quality instrumentation required to determine the enantiomer ratio of pollutions from environmental samples. GC-MS or HPLC-MS/MS chromatographic instruments and wearisome sample pretreatments are necessary for such analyses. No universal method is possible for chiral selective analyses. The members of enantiomer pairs are undistinguishable in homogeneous media. They can be separated only with asymmetric agents, with similar structures as the tested compounds [19]. Namely the chiral recognitions need three point interactions between the selectands and selectors. The selectors have to tightly fit to the selectands in space as well interaction types. Every enantiomer pair requires tailor-made selective separation media and conditions.

The most popular chiral selective stationary phases contain cyclodextrin derivatives in gas chromatography (GC) [20]. The high performance liquid chromatography (HPLC) chiral selective separations use mostly amylose or cellulose derivatives [21]. The fastest developing branch of chromatography is capillary electrophoresis (CE), where the cyclodextrins are the frequently applied chiral selective agents [22]. The figure 2 demonstrates well the chiral separations of production intermediates of pyrethroid pesticides.

Such electropherograms offer exact determination of enantiomeric ratio of these pesticides. The enantiomer pure agents decrease the burden of nature, but their wanted effects remains unchanged.

3 CONCLUSIONS

The chirality gains more and more important role in the environmental science. Enantiomer pairs can produce different pollution profiles. They have different metabolism, degradation rates and deposition in the nature. Chiral selective analysis can determine the origin, the age and the producer of the polluting materials.

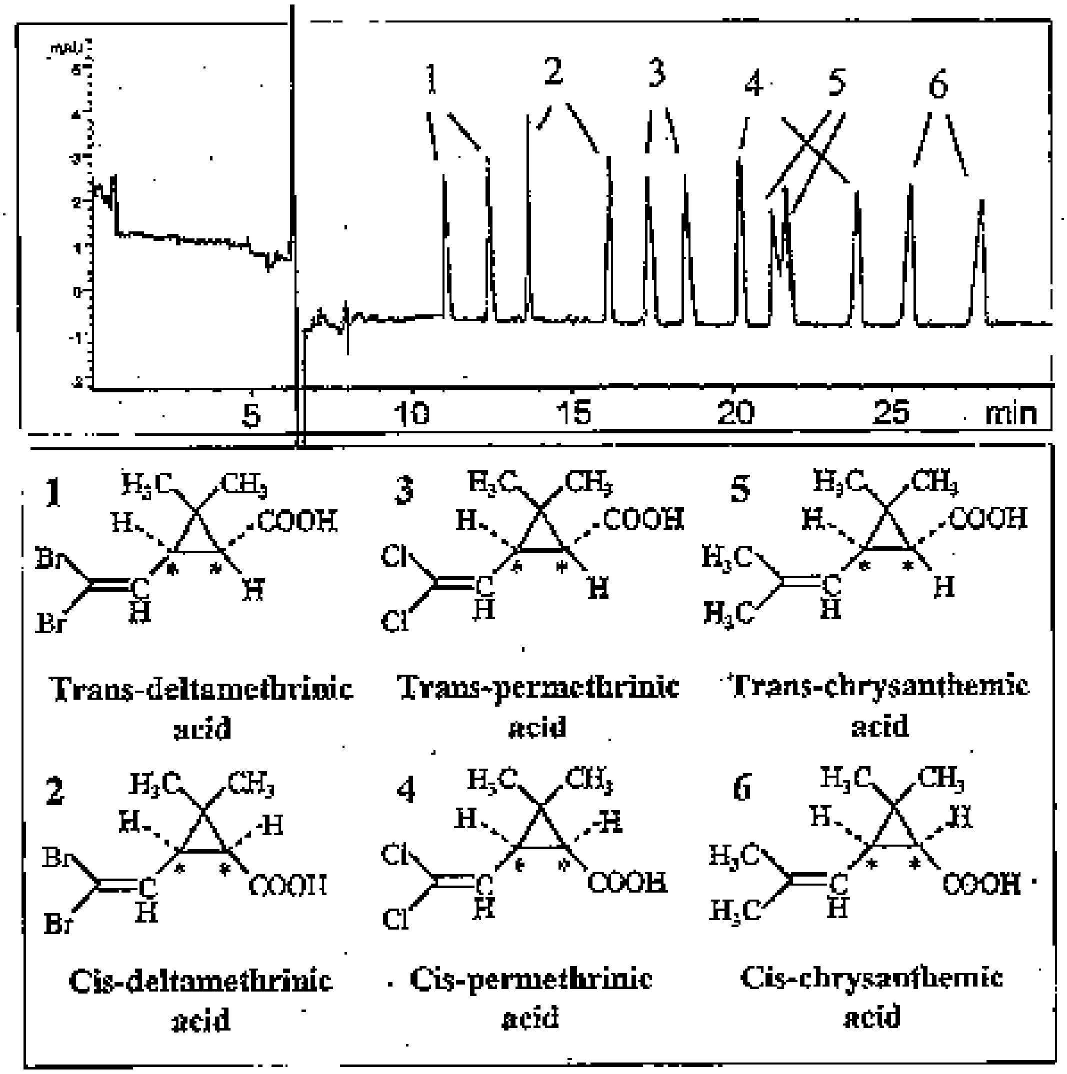

Figure 2: The upper part shows the chiral selective electropherograms of phyrethroid acids. The lower part shows the chemical structures of the peaks. Conditions: column, 58.5 cm x 50 µm FSOT; chiral selective agent, permethyl 6-mono-amino β-CD; background buffer, 40 mM Britton-Robinson; temperature, 25°C; power, 30 kV.

3 ACKNOWLEDGEMENTS

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PRACTICAL HOT STRESS ASSESSMENT METHODOLOGY FOR USE IN SLOVAKIA

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Abstract: *Average person spends about one third of day at work. During working hours in industrial workplaces, workers can be exposed to possible heat and cold risks. Evaluation of thermo-hygric microclimate during hot summer days is significant mainly in the case of workplaces where technological eguipment produces heat. At present the method used in Slovak Republic to evaluate thermo-hygric microclimate and industrial operations is based on comparing the measured values with current legislation.*

The paper deals with monitoring of workplace where technological equipment produces heat during hot summer days. The thermo-hygric microclimate measurement took place during daily work shift, and was carried out at 5 choosen measuring points. Since there was radiation heat presented in workplace and workers worked at different places, the thermal environment were classified as a heterogeneous and unstationary area. The measurement, result processing and interpretation were carried out according to the valid legislation of Slovak Republic.

Keywords: *Hot environment, thermo-hygric microclimate, measuring, evaluation.*

INTRODUCTION

Physical quantities of thermal-moisture microclimate (temperature, relative humidity, air velocity) define subjective feelings of comfort or discomfort. In extreme cases they can be qualified as pollutants with negative effects on human health. Basic information and general requirements for the internal environment of buildings as well as details and requirements for hygrothermal microclimate are stated in the Ministry of Health of the Slovak Republic č.544/2007 [1]. Monitoring of parameters of heat-moisture microclimate was conducted to assess conformity/ non-conformity with valid legislation in the interior of hot production facility.

PRACTICAL MEASUREMENT OF THERMAL ENVIRONMENT

Monitoring of thermo-hygric microclimate was carried out using the Testo 400, to which tri-functional probe was attached, three-level globe Vernon-Jokl thermometer. Used equipment meets ISO 7726 requirements for accuracy. Based on the movement of workers during their work shift, five measuring points were selected. These most frequent places were then monitored for 6 hours.

Along with measuring points, activities of workers were also analyzed and later served in overall evaluation of the measurement. Because there are two major sources of radiant heat in operation, variable air speed and people moving freely, environment was evaluated as a heterogeneous and non-stationary. Therefore it was necessary to perform measurements at three levels: head (1.7 m), abdomen (1.1 m), ankles (0.1 m). Results obtained from two measurement points were put into table and basic statistic was implied in calculation.

Outside climatic situation of workplace is also a part of the monitoring of thermo-hygric microclimate. During the measurement there was a sunny day and the outdoor air temperature was between 29 and 34 [°C]. Relative humidity was about 40 [%] and air velocity was about 6 [m.s^{-1}].

Experimental measurements of thermo - hygric microclimate

Three basic physical quantities of thermo-hygric microclimate were measured - R_h relative humidity [%], the dry air temperature t_a [°C] and air velocity v_a [m.s^{-1}] with measuring device Testo 400. Measurements took place in 5 measuring locations M1, M2, M3, M4, M5 during 6 hours. Measured values of thermo-hygric microclimate were processed in MS Excel. Basic statistical functions such as: min (the lowest value of the set of values), max (maximum value of the set of value|, average (arithmetic mean arguments), stdev (standard deviation), median (middle value of a group of numbers), var (variance values), mode (most frequently occurring value in a group of numbers) were used.
Measured values of dry air temperature, air velocity and relative humidity at each measuring points and at all three levels were statistically processed in MS Excel program (Table 1). Graphical processing of data obtained by measuring of Testo 400 is shown on the Figure 1, 2, 3. On the horizontal axis measuring time is shown while on vertical axis are values of dry air temperature, air flow velocity and the relative humidity.

Table 1: Statistical processing of the measured values on workplace M1

Function	R_h [%]			t_a [°C]			v_a [m/s]		
	Head	Abdomen	Ankles	Head	Abdomen	Ankles	Head	Abdomen	Ankles
min	32,2	32,7	31,3	29,7	29,6	25,4	0,03	0,01	0,02
max	48,6	46,8	47,1	36,7	36,1	36,1	0,51	0,71	0,66
average	39,30	38,34	39,13	33,01	32,74	31,99	0,19	0,2	0,18
stdev	3,31	3,13	3,39	1,264	1,13	1,41	0,06	0,08	0,08
median	39,3	38	38,9	33,05	32,8	32,2	0,24	0,23	0,25
var	10,98	9,83	11,52	1,6	1,28	1,98	0,004	0,01	0,01
mode	36,2	39,4	38,4	33	33,2	32,2	0,26	0,25	0,25
Mean value Φ	Φ_{Rh} [%]			Φ_{ta} [°C]			Φ_{va} [m/s]		
	38,78			32,62			0,19		

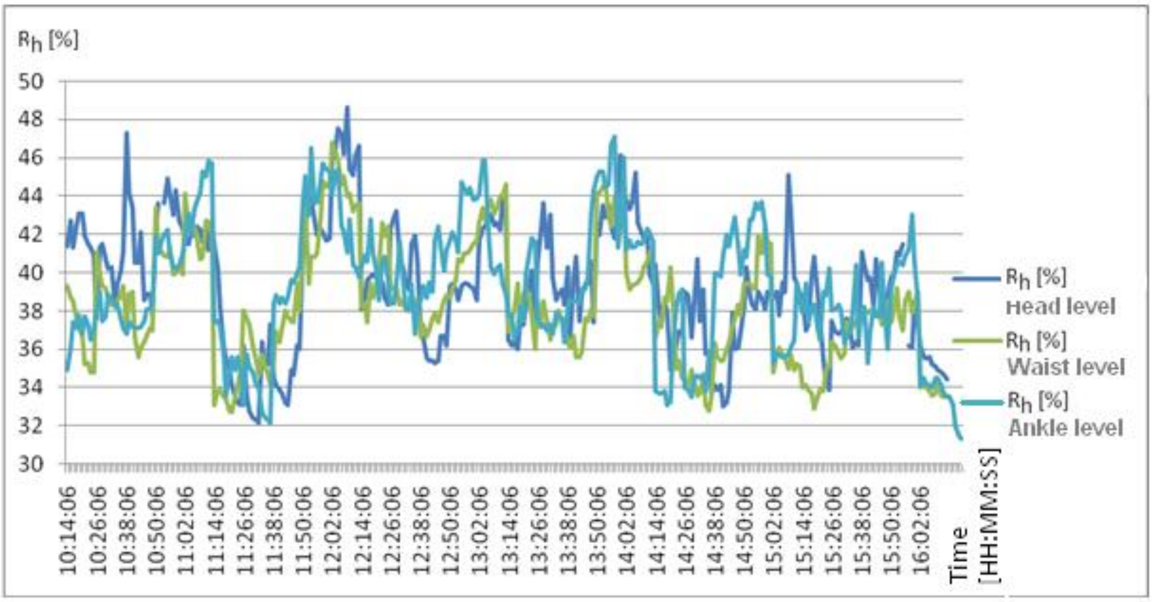

Figure 1: Overall progress of relative humidity

Figure 2: Overall progress of dry air temperature

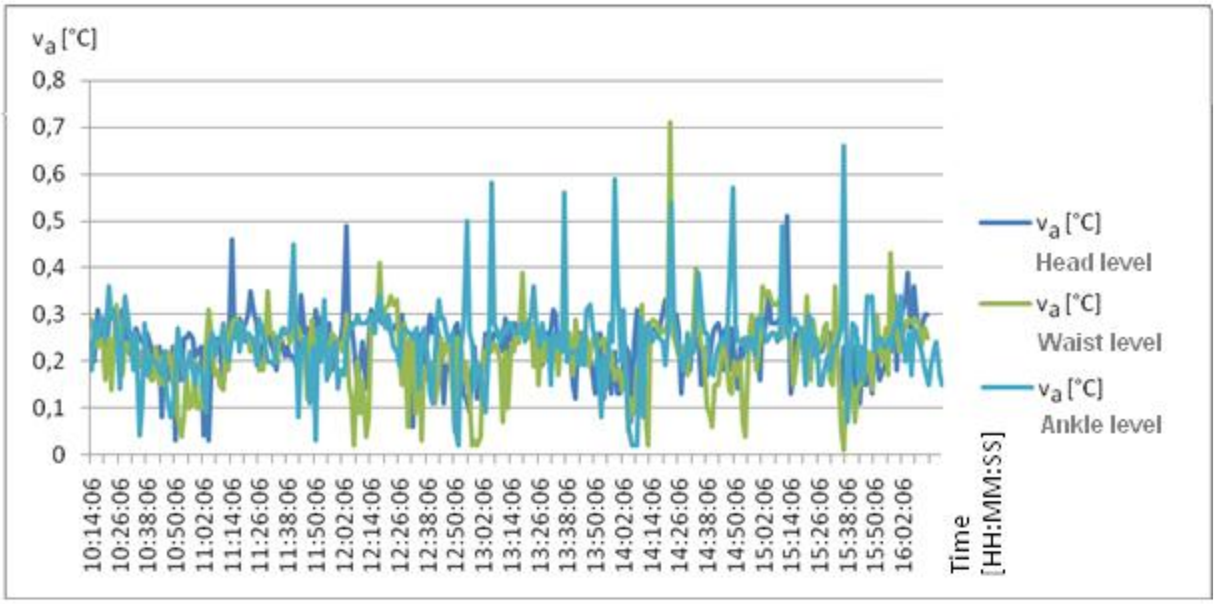

Figure 3: Overall progress of air velocity

Globe temperature

Temperature measurement obtained by globe thermometer was conducted in order to determine the approximate amount of mean temperature radiation $t_{r,\, m}$ [°C] by using the three level Vernon-Jokl thermometer. Black ball thermometer is used to derive the approximate value of mean temperature radiation from the observed simultaneous temperatures readings of globe temperature (t_g) [°C], air temperature and air velocity surrounding the sphere [2, 3]. Measurements done with this device were conducted at 2 measuring locations during working shift. The values of global temperature, measured by Vernon-Jokl were statistically processed (Table 2).

Graphical processing of data obtained by measuring of global temperature can be seen in Figure 4. On the horizontal axis measuring time is shown while on vertical axis the final temperature of the globe temperature is shown.

Table 2: Statistical processing of the measured values on workplace M1 – M5

<table>
<tr><th>Function</th><th>$t_{g\ head}$ [°C]</th><th>$t_{g\ abdomen}$ [°C]</th><th>$t_{g\ ankles}$ [°C]</th><th colspan="5" rowspan="2">Mean value Φt_g [°C]</th></tr>
<tr><td>min</td><td>36,5</td><td>35</td><td>33</td></tr>
<tr><td>max</td><td>40,5</td><td>38</td><td>36</td><td rowspan="4">M1</td><td rowspan="4">M2</td><td rowspan="4">M3</td><td rowspan="4">M4</td><td rowspan="4">M5</td></tr>
<tr><td>average</td><td>37,98</td><td>36,42</td><td>34,51</td></tr>
<tr><td>stdev</td><td>1,32</td><td>1,04</td><td>0,98</td></tr>
<tr><td>median</td><td>37,5</td><td>36,25</td><td>34,63</td></tr>
<tr><td>var</td><td>1,73</td><td>1,08</td><td>0,96</td><td rowspan="2">37,38</td><td rowspan="2">34,61</td><td rowspan="2">33,31</td><td rowspan="2">31,94</td><td rowspan="2">30,56</td></tr>
<tr><td>mode</td><td>37</td><td>35,5</td><td>35</td></tr>
</table>

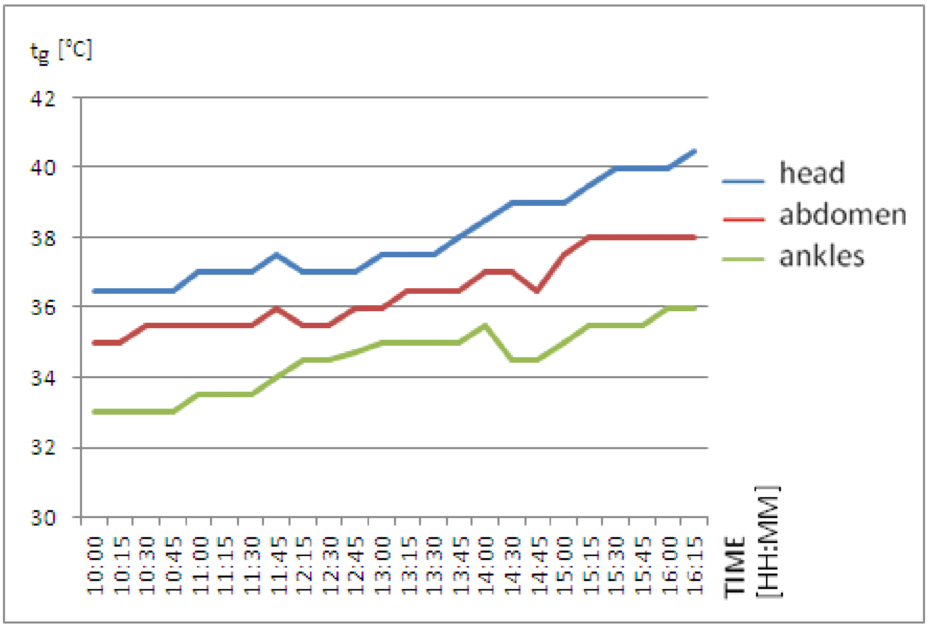

Figure 4: Overall progress of globe temperature

Measurement uncertainty

Due to the method of measurement, measuring instruments and measurement conditions, measurement uncertainty was evaluated (Table 3).

Table 3: Measurement uncertainty

Measured value	measuring range of instrument	measurement uncertainty
Dry bulb temperature	-20 až +70 [°C]	± 0,5 [°C]
Globe temperature	0 až 50 [°C]	± 0,5 [°C]
Relative humidity	0 až 100 [%]	± 3 [%]
Air velocity	0 až 10 [m/s]	± (0.05 + 5 [%] of v_a) [ms^{-1}] ± (0.02 + 7 [%] of v_a) [ms^{-1}]

EVALUATION OF MEASURED RESULTS

At present time in Slovakia the basic criteria for evaluating environmental parameters of indoor environment parameters are [4]: t_g, R_h, v_a. Operational temperature t_o [°C] is the uniform temperature of black space in which exchange of the same amount of heat transferred by radiation and convection in the actual non-homogeneous environments between human and environment occurs.

Operational temperature can be directly substituted for the resulting spherical bulb temperature when the air velocity $v_a < 0.2$ [ms^{-1}] [5]. Table 4 shows the optimal and acceptable conditions of heat and moisture microclimate for hot and cold time during the year stated in standard of wear by decree of the Ministry of Health of the Slovak Republic č.544/2007 which includes the details of health protection against heat and cold load at work. Warm period of the year is defined as the period with average daily outdoor air temperature higher than 13° C.

Table 4: Optimal and acceptable conditions of heat and moisture microclimate for the warm period of year [1]

Work class	**Operative temperature** t_o [°C]		**Tolerable air velocity** v_a [m.s^{-1}]	**Tolerable relative humidity** R_h [%]
	optimal	**tolerable**		
1a	20 – 24	17 – 26	< 0,3	30 to 70

Values t_o, R_h, v_a are used for standard clothing R_{cl} = 0.3 to 0.5 [clo].

Based on the statistical processing and calculation results for each measurement location were obtained (see Tab. 5). There results were then compared with the limits stated in the legislation (Table. 4).

Table 5: Assessment criteria

Measuring location	**Mean value**			
	t_0 [°C]	**R_h [%]**	**v_a [m/s]**	**t_g [°C]**
M1	37,38 ± 0. 5 **Not acceptable**	37,25 ± 3 **Acceptable**	0,27 ± 0.05 **Acceptable**	37,38 ± 0. 5
M2	34,61 ± 0. 5 **Not acceptable**	37,25 ± 3 **Acceptable**	0,23 ± 0.05 **Acceptable**	34,61 ± 0. 5
M3	33,31 ± 0. 5 **Not acceptable**	37,77 ± 3 **Acceptable**	0,21 ± 0.05 **Acceptable**	33,31 ± 0. 5
M4	31,94 ± 0. 5 **Not acceptable**	41,42 ± 3 **Acceptable**	0,20 ± 0.05 **Acceptable**	31,94 ± 0. 5
M5	30,56 ± 0. 5 **Not acceptable**	40,19 ± 3 **Acceptable**	0,22 ± 0.05 **Acceptable**	30,56 ± 0. 5

DISCUSSION

In areas designated for long-term stay of people, optimal conditions for heat-moisture microclimate in hot and cold times during year are provided. Warm period of the year is stated as period during which average daily outdoor air temperature is 13° C or higher. When average daily temperature falls during two consecutive days below 13° C, the studied area is then evaluated according to the values for cold time period of the year. Optimal and acceptable conditions of thermal-moisture microclimate are determined according to work classes where total heat production of the body is evaluated.

CONCLUSION

Values of air speed and relative humidity at the time of measurement were in accordance with the tolerable values of flow velocity and relative humidity, while the values of the temperature were not in the tolerance with optimal operational temperature values of for hot period of the year and for a given class work (class work 1c locations M1-M5) according to Decree of the Ministry of health of the Slovak Republic č.544/2007 which contain details of health protection against heat and cold load at work during the time of measurement.
Hot summer days are increasing the temperature inside of the building. That is why ventilation and air conditioning systems are common. In many manufacturing plants temperature and humidity are provided by air conditions. If hot industrial facilities are not able to provide air condition they must provide at least natural ventilation. Nowadays tropical days are more frequent and because of that it is recommended to use air conditioning in hot industrial plants in the future.

Acknowledgment

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RADIATION INDUCED DEGRADATION OF ORGANIC TEXTILE DYES IN AQUEOUS MEDIA

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Abstract: *Coloured wastewater containing synthetic organic dyes and pigments is produced in large volumes in the industry and may enter the environment during the production and manufacturing process. Since most of these dyes are biologically resistant, for the treatment of resulting wastewaters they represent a serious problem. The dye containing wastewater can be effectively degraded by conventional methods after treatment by high energy irradiation. In dilute solutions the chemical transformation of the solute is induced by the reactive intermediates formed during water radiolysis* $^\bullet$*OH radical and* $^\bullet$*H atom.*

Little is known about the mechanism of the radiolytic reactions of the dyes [1]. The purpose of the present work is to suggest mechanism for the OH radical induced destruction of Apollofix-Red, a reactive azo dye in aqueous solutions.

It was found by UV-Vis spectroscopy and after HPLC separation by diode array detection that Apollofix-Red in aqueous solution can be effectively degraded by OH radicals produced in the radiolysis of water. In the first degradation step (at low doses) the OH radical attacks the benzene ring and OH derivatives of the starting molecule form.

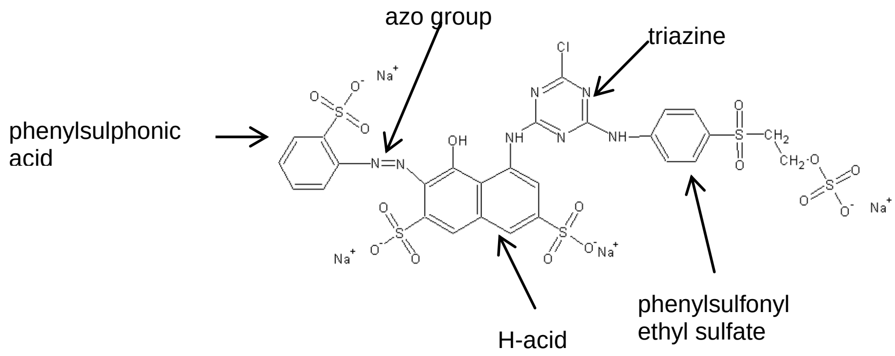
Keywords: *radiation induced degradation, textile dyes, wastewater*

1. INTRODUCTION

Radiation chemical treatment of industrial wastewater is an emerging technology used on the pilot plant level at some places and there are also a few technologies established on full-scale level [1,2].

The textile industry utilizes several thousands of synthetic organic dyes and pigments. Coloured wastewater is produced in large volumes and may enter the environment during the production and manufacturing process. Since most of these dyes are biologically resistant, for the treatment of resulting wastewaters they represent a serious problem. The dye containing wastewater can be easily and effectively degraded by conventional methods after treatment by high energy irradiation.

In dilute solutions the chemical transformation of the solute is induced by the reactive intermediates formed during water radiolysis $^\bullet$OH radical and $^\bullet$H atom, and in the presence of oxygen also the $^\bullet O_2^-/HO_2^\bullet$ pair). The overall yield of intermediates that may react with the solute is G ~ 6.0 species/100 eV radiation energy absorbed.



Apollofix-Red

Little is known about the mechanism of the radiolytic reactions of the dyes [3,4,5]. The purpose of the present work is to suggest mechanism for the OH radical induced destruction of Apollofix-Red, a reactive azo dye in aqueous solutions.

2. METHODS

AR was obtained from Taiheung Corporation (Kyunggido, South Korea) and was purified by recrystallization from methanol/ethanol mixtures. Its structure and stability was checked by NMR and FTIR spectroscopy. We used perchloric acid or sodium hydroxide to set the pH of the solutions. Gamma radiolysis was carried out using a ^{60}Co irradiation facility with a dose rate of 2.0 kGy h^{-1}. The solutions were bubbled with N_2O for 5 min prior to irradiation in Pyrex glass ampoules which had attached Suprasil quartz cuvettes for taking the UV-VIS absorption spectra before and after the reaction. The spectra were measured by using a Jasco 550 UV-VIS spectrophotometer.
The *HPLC* chromatographic system consisted of a Jasco PU-2089Plus quaternary gradient pump, a Jasco MD-2015Plus diode-array Multiwavelenght Detector and a Nucleosil 100 C18 column (Teknokroma®) (pore size 5 µm, length 15 cm, diameter 0.4 cm). Gradient-elution ion-pair separations were made using 50 mmol dm^{-3} aqueous solutions of TBAHS (tetrabutyl-ammonium-hydrogen sulfate) at pH 6.1 and methanol.
All mobile phases were filtered using a Millipore 0.45 µm filter and were degassed by ultrasonication before use. The separations were made at room temperature using injection volume of 10 µl, and flow-rate of 0.8 ml/min.
The radiolytic reactions were investigated by applying the standard radiation chemical techniques. The radiolysis of water supplies e_{aq}^-, ${}^\bullet OH$, and ${}^\bullet H$ atom reactive intermediates with G-values (species (100 eV)$^{-1}$) shown in equ. (1). In order to reduce the number of reactive intermediates, the reactions of OH radicals were studied in N_2O saturated solutions, in such solutions the hydrated electrons are converted to OH radicals (Reaction (2)) [6].

$H_2O \rightsquigarrow e_{aq}^-, {}^\bullet OH, H$ $\qquad G(e_{aq}^-) = 2.7;\ G({}^\bullet OH) = 2.7;\ G({}^\bullet H) = 0.6$ $\qquad$ (1)
$e_{aq}^- + N_2O + H_2O \rightarrow N_2 + OH^- + {}^\bullet OH$ $\qquad k_2 = 7 \times 10^9\ mol^{-1}\ dm^3\ s^{-1}$ $\qquad$ (2)

3. RESULTS

The absorption spectrum taken in 8.5 × 10^{-5} mol dm^{-3} solution of Apollofix-Red without irradiation (0 dose, Fig. 1A) in addition to the double peak band having maximum absorbancies at 514 nm and 532 nm with ε_{532} = 31 400 mol^{-1} dm^3 cm^{-1} [3], has another intensive band at λ_{max} = 297 nm with $\varepsilon_{max} \approx$ 50 000 mol^{-1} dm^3 cm^{-1}. Using TBAHS as eluent for the HPLC separation of unirradiated AR in aqueous solution we obtained two components AR I and AR II and no other resolvable peaks were observed. These two components had practically the same absorption spectrum with different elution time; however, the ratio of the two peaks could be influenced by different procedures. We assume that one of the peaks, AR I, belongs to Apollofix-Red with the formula shown in the Introduction and the other belongs to its derivative with hydrolysed sulfonyl group from the ethyl moiety [7,8]. Since this part of the molecule is not in conjugation with the H-acid part, this hydrolysis practically does not influence the absorption spectrum.

In the irradiated solution beside the AR I and AR II components, another two major and some other minor components were detected. One of the intermediate products (P I) has practically the same absorption spectrum as the starting compounds, whereas in the case of the other product (P II) the spectrum is slightly shifted to longer wavelengths as compared to the spectra of the non-reacted molecules.

The destruction of AR I and AR II and the formation of the degradation products, P I and P II as a function of absorbed dose were followed by HPLC with diode array detection (Fig. 1B). The absorbances of AR I and AR II decrease quickly with the dose. P I and P II show maximum absorbances at 0.2 kGy dose. Especially at higher doses other components were also observed on the HPLC chromatograms and above 1.5 kGy dose all of the compounds that show absorbance in the VIS range disappeared.

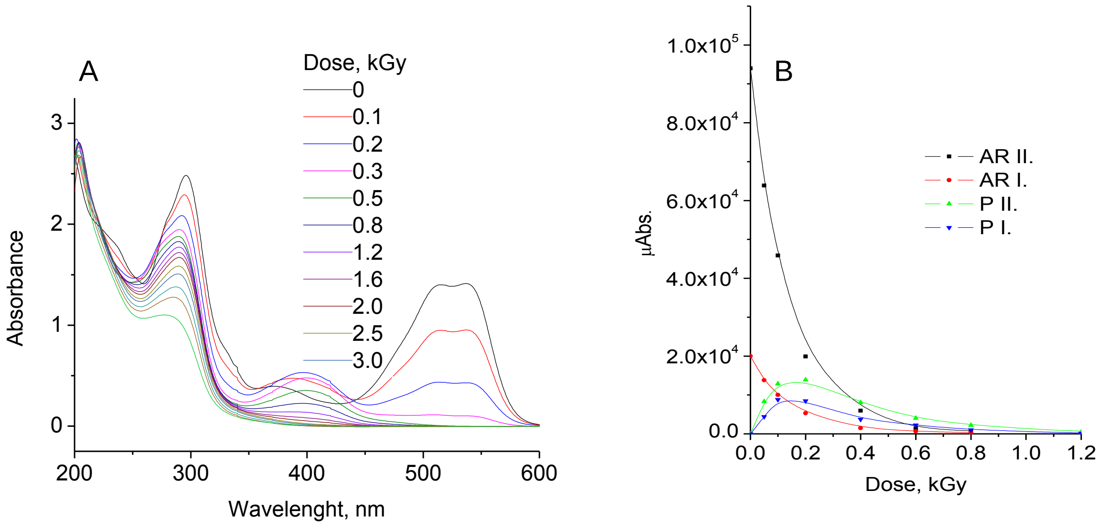


Figure 1 Discolouration of 0.085 mmol dm^{-3} concentration aqueous AR solutions in the reactions of hydroxyl radicals in N_2O saturated solutions (A). Destruction of AR molecules and formation of degradation products in OH radical reactions as detected by HPLC at 530 nm (B)

From the dose dependence curves it seems that the reactivity of the intermediate products towards the •OH is similarly high as that of the starting compounds. This is obvious also from Fig. 1A, which shows the absorbencies measured both in irradiated and unirradiated solutions. This dose dependence can be due to a stepwise destruction of colour giving centre in the molecule. Finally we obtain compounds having no light absorption in the visible range.
Large molecules like AR have several places for the attack by •OH radicals. It is well known that •OH radicals attack the aromatic rings with practically diffusion limited rate coefficients forming cyclohexadienyl type radicals [9]. The reaction of this radical with another cyclohexadienyl radical (or with any other radical present) may regenerate the aromatic ring structure.
In the disproportionation reaction an aromatic molecule containing an additional OH group also forms. If similar reaction of the •AR-OH adduct radical takes place, we obtain an Ar molecule that has an additional OH group attached to one of the aromatic rings. If this ring belongs to the conjugated phenylsulphonic acid–azo group–H-acid part of the molecule the absorption spectrum is slightly shifted to longer wavelength, so we obtain P II. However, if the product formation takes place after •OH addition to the aromatic ring on the phenylsulfonyl ethyl sulphate part of the molecule the final product OH group containing molecule (P I) will practically have the same visible absorption spectrum as AR since the chromophoric group, that is the conjugated part of the molecule is not altered. As Fig. 1A shows the absorbance in the visible range gradually decreases with the increasing dose of irradiation, and at the same time there is a shift of the band to longer wavelengths supporting the idea of incorporation of an OH group into the chromophoric part of the molecule [10].
•OH addition to triazine ring, based on analogies [11], is a slow reaction. The •OH radicals may add to the azo group: this reaction probably immediately leads to the destruction of the intensive colour in the visible range [12].

4. CONCLUSIONS

Apollofix-Red, a reactive azo dye in aqueous solution can be effectively degraded by OH radicals produced in the ionizing radiation induced radiolysis of water. In the first degradation step (at low doses) the OH radical attacks the benzene ring and OH derivatives of the starting molecule form.

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TRENDS IN ENVIRONEMTAL FIRM MANAGEMENT

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Abstract: *The article describe trends and methods in the control which should be used in organizations for earning control effectively and successful target reaching by filling a company vision. Modern managing set-up should be in any company in-step with company's organizational structure. A situation in Slovak companies needs an experts and competent people in top –management that should effectively react on new coming environmental conditions. Increasingly become to situations, which are impossible to handle by traditional manager techniques, and they need to use of modern set-up and access sufficient to arise environmental situation.*

Keywords: *Management, management methods, organizational structure, effective environmental management, environmental benchmarking.*

INTRODUCTION

Companies, which want to reach a success, must be a flexible organization, learn how to innovate so they can react on constantly changes of setting. Modern American companies use methods that signify reversion to classical and neoclassical management school. Centre of American access are mainly possibilities of horizontal production organization, total quality control, continual improve of all environmental actions in company also a attentions to relationships with costumer, participative management and on top application of system which are built on computer technique[6,7]. In Slovak condition we can very hard to compare with American companies of course so we do have very good companies but since they are small or medium sized they do have problem with. Very important is a creativity of manger and business plan [2]. Application knowledge management in the practice of business subjects in Slovakia is also on of method which can be used as a new way of company management. [2] We decide to dedicate this article to Benchmarking Method – is method builds on comparing own organization with chosen example competitor and there adaptability with analyzes solution. As an example organization we consider that which in long period of time reach better results than analyze organization whereby essence resets not in founding and devolution complete examples bur in way of founding better solution. By using this method is to assure competitiveness and organization development there through will be use other approved method. These take us to creating perfect copies but not to competitiveness. The key positions by application of environmental benchmarking have information about those that are comparing with quality and scope. The depression of this method rests in problem with assurance determine factors for externally oriented success. Our study deals with problems in bricks companies, which had problems with efficiency of transportation and there high environmental burdens. Possibility of using structural funds can also support competing in

benchmarking so company have a good back round to reach a money even a creativity in work experience can help to go further. [12,8]
Effective company control is support by plenty modern manager tools from whom in higher rate should be use reengineering, benchmarking and an outsourcing. Those should be also eliminating weak place in company as are over employment and high costs. Many of the new method in company management are on volunteer activity. With the similar problems were working many authors in strategy management and volunteer environmental tools [10,11]

EXPERIMENTAL

Currently, many of Slovak companies realize that if they want to succeed on market, they must go through many changes. These changes would entail a long period and enterprises must be based on the options that are available [3,4]. Often face difficulties with outdated technology, poor company culture, education level of workers, decrease in quality of products and competitors. Low level of capital market efficiency in obtaining funds in SR reduces the possibility of implementing innovative potential (including environmental) business plans in the private sector. [9]
When it is obvious that it is the quality of production in many cases become an important means of competitive struggle. The market economy has found its place on the world market and globalization has resulted in increasingly stronger competition. Enterprises must strive to ensure that competitors had a chance to print them. This means that they must constantly improve their products, services, processes and flexibly adapt to market conditions.[5]
Analysis of state firms in terms of applications - Environmental benchmarking provides information that is the basis for finding problem areas for possible improvement and propose concrete options to mitigate the negative impact of production on the environment.
When the processing was used business documents, information collected surveys and interviews with workers with the issues involved in the organization, as well as production workers.
The most commonly applied method is dialogue with employees at different hierarchical levels, which is time consuming, but involves subjective effects of respondents. In the implementation of environmental benchmarking that the principles defined in the previous sections. We are focused on organizations that offer a similar range of products and services.
The need for more detailed analysis, we focused on the company and because of its size and availability. The second choice is by B, which is a benchmark - a strong competitor because of the long tradition and image of the company. Taking into account the market situation and the technical and economic possibilities were chosen as the most suitable partner B specific chamotte.
Both companies have similar production program focused on the production of refractory bricks. In comparing the companies, we take into account their market position and their three basic indicators, which are listed in Table 1.

Table 1: Market research

Indicators	**Benchmark company A**	**Competitive company B**
Market share in %	36	48
Consumers are notified in%	52	45
Popularity of product in %	40	50

The analysis results in Table 1 are that company B in the expression of% of market share and popularity has a dominant position in relation to competitors. Most Popular product in our understanding is the use of the goods of the company, in terms of popularity among customers. It is also the strength of the company and the opportunity to retain such status. Share of consumers' talks about how consumers are informed about the existence of the business and their products. This indicator recorded a higher score in the company A, therefore, can be considered as the indicator for the company B for a particular threat from competition, but also an opportunity to improve the indicator.

The processing of the information

The processing of the information received was a major aim, to put the data into a form that would allow them easy to understand and use. Ranking factors in Table 2 were prepared on the basis of familiarity with the activities of both companies. Graphical representation is shown in Figure 1 Based on analysis by scoring was observed importance of individual factors of equity and Loan Company, which significantly affect the environment. Evaluation scale is from 0-50, with higher number means a higher percentage.

Table 2: Achievement company factors

Internal factores	**Company A**	**Company B**
Sales force	48	52
Marketing	46	51
Research and development	38	43
Production	38	37
Distribution	35	31
Financial resources	37	40
Image	36	36
Quality	31	34
External factors		
Ecology	33	38
Market size	42	38
Profitabiltiy of the sector	40	40
Technology	39	42
Availability labor force	42	48
Legal issues	44	44

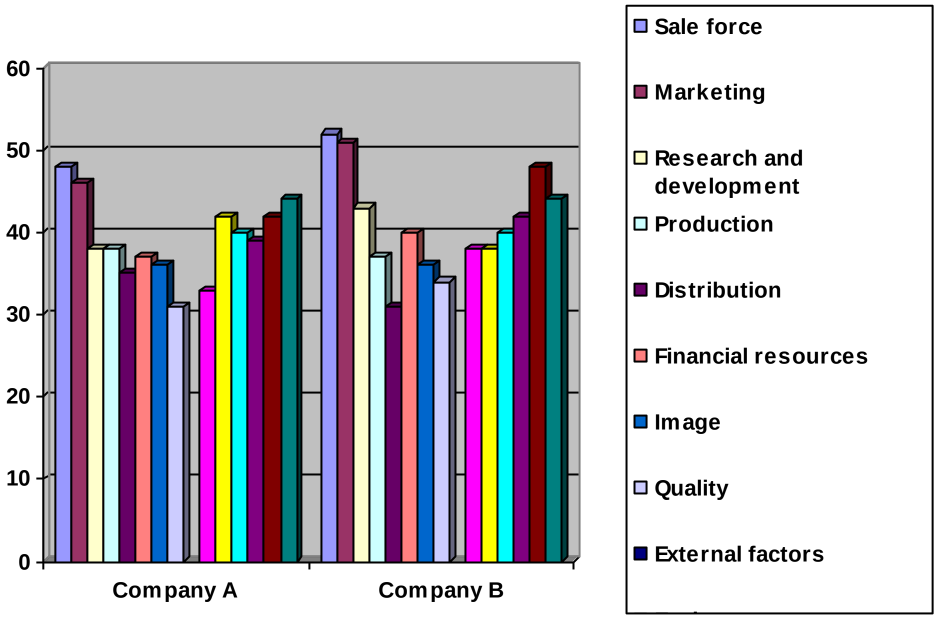

Figure 1: Graphical representation of the factors

The analysis is made clear which factors are critical to the establishment and the company considers its competitive edge. Comparing these factors, it is possible to observe changes in the importance of individual factors. In terms of competitive advantage, it is necessary for the company A to focus attention and orientation precisely on the factors of low value, which reduce the competitiveness and overall efficiency.

The evaluation of the present environmental situation in benchmarked companies

For assessment of the environmental situation was used questionnaire method. The evaluation method for environmental impacts in environmental benchmarking is based on the mutual comparison of the two companies based on selected criteria, which are listed in Table 3. The aforementioned criteria constitute impacts on the environment.
First of all is to make a selection effects. Based on the environmental review of the previous years, the experience gained by regular environmental impact assessments and analysis of the significance of environmental aspects are ranked among the most important aspects of the effects found in Table 3.
Each impact was based on subjective decisions assigned a specific weight. The sum of all weights is equal to one. Scale score is in the range of 1-5, while the maximum score is 5, which is the company with the highest comparative advantage in the area of evaluation. The resulting value is the product of the points and weights of each factor. It is true that the higher the number, the better competitive advantage.

Table 3. Compression of environmental impact

Criteria	Weight v_i	Compnay A		Comapny B	
		Points(b_j)	Multiplying	**Points(b_l)**	Multiplying
The energy consumption	0,12	3	0,36	4	0,48
Waste Management	0,10	3	0,30	5	0,50
Technological process	0,13	4	0,52	3	0,39
The dustiness	0,14	2	0,28	3	0,42
Noise and vibration	0,15	3	0,45	4	0,60
Environmental policy of the company	0,11	3	0,33	4	0,44
Scrap quantity	0,09	4	0,36	4	0,36
The air pollution	0,08	3	0,24	4	0,32
Increasing environmental quality	0,08	3	0,24	3	0,24
Execution			**$v_i * b_j$**		**$v_i * b_l$**
Sum	1		**3,08**		**3,75**

3. RESULTS

Options for improving the situation of the company A, which involves benchmarking are as follows.

a) Reducing the cost of examining the material flow

Significant cost item is the basic material consumption (raw materials). The basic material joins the company (is purchased from an external supplier and cost awards) and is consumed in company products are designed to meet the needs of customers. Observation of material flow and material flow analysis provides information not only on the value of material input into the company, but is also a source of information on the cost of processing this material in various stages of production. It is possible therefore pursues a gradual increase in the value of material that is through work in progress and semi-finished stocks of finished goods for consumers. During the manufacturing process lead to loss of material, its degradation, and consequently may produce low-quality products and wastes. This analysis informs the user not only the costs incurred in the production of products, but also the "value" of poor quality products and wastes. It is possible to find activities and places where losses occur and the waste products of poor quality and waste. On the basis of this information can propose and adopt such measures, which will lead to a more efficient use of materials and energy, mitigate the impacts of corporate activities, products on the environment, reduce environmental risks and bring in the final stage and improve the results of the company.

b) Adding value through environmental challenges

Some companies have created programs to add value through product response to environment. As an example are some steps that company B has applied to address environmental problems resulting increase in the value of the product:

Strategy and organization

- Removal of environmentally less safe operations.
- Research and development activities more considerate to the environment.
- Compensation for environmentally hazardous activities.

Public Affairs

- Efforts to prevent loss.
- Efforts to get environmental credibility.

Legal requirements

- To avoid confrontations with the authorities for pollution control.
- The early subordination to law.

Production operations

- Supporting technological advances that reduce the environmental burden of production processes.
- Exploitation of new production technologies.
- Modification of production equipment and manufacturing operations amendment.
- Minimizing of waste production.
- The effort to find alternative uses of waste.
- Recycling Activities.
- Optimizing of electricity consumption.

Marketing

- The effort to represent the products in the green point of view.

Accounting

- Pointing out that programs to eliminate pollution are advantageous.
- Pointing out the overall impact of pollution reduction program.
- Prevention is better than cure.

Finance

- Obtaining the respect of the Community eco-oriented investors.
- Recognition of the actual responsibility for damage caused to the environment.

DISCUSSION

When is benchmarking properly implemented, than can lead to dramatic improvements in an organization’s processes. However, there are several pitfalls that can undermine the efforts and turn benchmarking into an expensive process which does not yield the benefits expected The company's success depends on the cooperation of users of environmental information, because they provide the resources necessary to ensure viability. The company needs from users like material as well as immaterial resources (including information and services) that are provided by individual operators as long as the interrelation considered reasonable and fair. To verify this variableness are required information, which must be continuously collected, organized and sold to users.

CONCLUSION

Environmental issues and ways for improvement should not be tackled in an isolated way. Improvements in the environmental dimension have to be compatible with financial constraints and social issues. The responsibilities for environmental protection and providing environmental services are increasing, and so are the costs related to them.

However, especially concerning costs of environmental protection or the citizens' satisfaction concerning environmental services, due to lack of comparison companies often do not know how well or how badly they are really performing and at what level they should set their goals. Comparisons with other companies can in this sense help them to find out where they stand and where the performance gaps are. Environmental friendliness is also increasingly used as a marketing argument for companies in order to be more attractive for new customers and suppliers. Deciding what to benchmark does not necessarily pre-define the purpose of the project. The goal of the improvement might concern the actual quality of the state of the environment in one case, whereas in another case the focus could be on environmental costs or the satisfaction of the citizens with environmental services which them offer companies as a goodwill.

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NUCLEAR POWER IS ONE OF THE WAYS TO SOLVE THE ENERGY NEEDS OF HUMANITY AND THE PROTECTION OF THE ENVIRONMENT

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Keywords: *nuclear energy, energy needs, power stations, environment*

Issues of nuclear power industry are getting particularly important in present day situation. This is due to the fact that nuclear energy is an area of the economy, which encompasses the study and use of atomic energy (the least amount of a chemical element, which consists of a nucleus and electrons) (in particular U- 235). At the same time, nuclear power is always accompanied by a debate about its necessity and danger.

Perhaps, nowadays we do not think how much we need and depend on electricity, but we use it all the time. A plane, a car, an elevator and even a magnetic door in your house becomes useless without electricity. We cannot make a phone call, and even turn it on, there's no light on the streets at night, a watch stops. Not saying a word about computers or satellites. But all these require not so much energy as may seem. Lion's share of electricity is used by the metallurgical, chemical and coal industry.

Thus, in this paper we present the basic provisions on nuclear energy and the need to evaluate its safety for the environment, revealing the specific issues of operation and safety of nuclear power plants (NPPs).

As it is well known, to ensure the normal standard of living it is necessary to produce a certain amount of energy per inhabitant of the planet. At present, the world can be divided into three groups.

The countries of Western Europe, North America, Japan, Australia and others belong to group 1. They have similar electricity consumption per one inhabitant. The standard of living in these countries is high, as measured by life expectancy and energy production per one inhabitant. Average life expectancy in Japan is more than 82.15 years in Europe – up to 82.1 years, in the United States – about 78.3 years. Energy production per capita in 2008 in Japan was for about 40,000 kWh / capita, in Europe – 40821 kWh / capita, while in the U.S. – 87216 kWh / capita.

The second group is complied by countries of the emerging economies. Among them are China, Brazil, Russia, Ukraine, etc. In these countries, life expectancy is shorter than in the countries from the first group, as well as the production of electricity is less. For example, in Russia average data for male – 62.77 years and 74.67 years female, energy production in 2007 was 7012 kWh / capita. In Ukraine, the average life expectancy of men is up to 62.1 years, for women – to 73.8 years, the production of the energy in 2011 was 4252.4 kWh / capita.

The bulk of African countries refers to the third group. In these countries, the need for energy sources is somewhat smaller as they are located in areas with warm climates.

Thus, the average life expectancy in Africa for men is 49.3 years, for women – 52.4 years. It should also be noted that the production of energy per capita in Africa in 2009 was 267 kWh / capita, which is about 153 times less than in Europe, in 326 times less than in America, and about 16 times less than in Ukraine.
All above mentioned makes it clear that the countries of the second and third groups will increase the production of energy in order to improve the quality of life in their countries.
Currently, about 5 billion people out of 7 billion of world population live in countries of the second and third groups. Therefore, the amount of energy produced in the near future is expected to grow at about 2–3 times.
But being so necessary, how much hazardous to human health and the ecology of the planet can be this energy?
It is well known that at the present time, the energy is produced by the chemical reaction of combustion of carbon, hydrogen, or co-firing. The latter reaction is realized by burning oil, coal or gas. In all these cases, large amounts of carbon dioxide and water are produced. Both of these substances lead to the greenhouse effect in the atmosphere and changing the climate. The changes of the Earth climate are reliably observed by all environmentalists around the world. This warming is accompanied by instability of weather, namely heavy rains or droughts, sharp frost or heat, sea level rise.
So, humanity faces a big problem: to increase production of the energy and not to harm the ecology of our planet.
In Ukraine, the greatest amount of energy is produced by solar power plants, hydroelectric power plants (HPP), thermal power plants (TPP), nuclear power plants (NPP), etc.
It should be noted that the coefficient of performance (COP) of the solar power plants today is about 30%. At the same time, in recent years the rate of efficiency has increased to such an extent that they can be used to meet the household needs of humanity. But for the chemical and metallurgical industries the power of solar plants is not sufficient.
The second type of power plants – hydropower plants – tied to the location: they need the river, the height difference and significant areas to be flooded during the construction of the dam. In Ukraine such kind of resource is practically used and there is little scope for its rapid development.
The next type of power plants – thermal power plants – has the largest share in the total energy production in Ukraine. But modern types of thermal power plants (of 2, 4 million kW) spend up to 20,000 tons of coal per day and emit 680 tons of SO2 and SO3, 200 tons of nitrogen oxides, 120–240 tons of ash, dust and soot in the percentage of sulfur in the fuel source 1,7. So it is very harmful for the environment.
The fourth type of power plant – nuclear power plants – produce the greatest amount of energy of all types of power plants in the exact place (nuclear power capacity is 1 million kW), which is essential for the metallurgical and chemical industries. This does not require a large amount of fuel, and hence it is much less emissions.
In particular, Ukraine has large reserves of uranium and its stocks, according to the assessments of the World Nuclear Association made in 2007, ranked tenth in the world, accounting for about 200,000 tons. At the same time, our country has a wealth of experience in operating nuclear power plants, as well as the unique experience of the removal consequences of the accident at the Chernobyl nuclear power plant.
But we cannot forget about the harm of nuclear power plants. Thus, the water-water reactor forms annually about 40,000 Ci, that ≈ 14, 8 * 1014 gaseous radioactive waste. With emissions from nuclear power plants are not a number, but by the degree of radioactivity. There is also the problem of disposal of nuclear waste, which makes the area unsuitable for the existence for many years, sometimes for hundreds of years. It should be noted that these problems are solved today.

The main problem of nuclear power plants, as international experience shows, is the nuclear accident. They cause death in people, animals and land pollution, destruction of buildings and expensive equipment, as well as the migration of radiation dust.
Analysis of accidents at nuclear power plants shows that they are caused by human errors rather than technical problems, work equipment. At present, nuclear power industry has almost 60 years of active operation of nuclear reactors and during that time greater experience has been accumulated in this field. Therefore, a crucial role in the safe use of nuclear energy should be paid to such factors as: the qualification of personnel and their professionalism.
Thus, the focus of the use of nuclear power to address energy needs and environmental protection must be given to the training of highly qualified personnel of the nuclear power plants, from technicians to operators.

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INVESTIGATION OF HEAVY METALS UPTAKE BY SPRING WHEAT AND COMMON BEAN PLANTS FROM SLUDGE-CONTAMINATED SOIL

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Abstract: *Soil samples were treated with different levels of sludge 0, 30, 50, 70, and 100% (soil:sludge, w/w) per pot. Results showed that, the Fe contents in the roots of spring wheat and common bean were more than the Fe contents detected in shoots of the both plants. Also increasing in the amount of Zn in the shoots and roots of were recognized, the amounts of Zn content in common bean were higher than those amounts detected in spring wheat by at least 1.5 x The Zn content in the roots of spring wheat was less than the amount present in the root of common bean. The microelements (Cd, Cu and Pb) concentrations were increased by the increasing the applied rates of biosolid in the soil. These increases were under the standard level provided by EU. The amount of Cd uptake by spring wheat was found to be higher than uptake by common bean plants; meanwhile there was a significant difference between the Cd up take and the applied sludge doses and among the amounts taken up by the plants, as well. However, the uptake of Pb by the root system in the spring wheat was higher than the uptake amounts by shoots. The maximum amount of Pb detected in roots was 0.56 mg/kg, and in shoot, it was 0.383 mg/kg. While in the case of common bean, the uptake of Pb was lower than the amount uptake by shoot system. The results illustrated that the amount of Pb uptake by shoot in common bean were more than 7 x the amount of uptake by shoot of spring wheat at 50% sludge contained in the models and 4 x at 100%. Maximum amount of Cu uptake at 100% sludge containing system by spring wheat and detected in the shoot was nearly 0.071 mg/kg, while the amount found in the root was about 0.037 mg/kg. In the case of field growing common bean plants, it was found that there were no significant differences among the amount of Cu uptake by roots of various media.*

INTRODUCTION

Contamination of soils by trace elements is as good as irreversible because the amount of many elements, especially heavy metals, lost by leaching and removal by crops is small. There is no general method of remediating soils contaminated by trace elements, even though there are some plants that take up significant amounts of certain trace elements. Application of trace elements to agricultural soils therefore leads to an increase in concentrations in soil unless application is so small that it is balanced by amounts removed and these higher concentrations will continue to exist for hundreds and thousands of years.

Many other countries have set limits on amounts of certain metals allowed in sludge from sewage treatment works that is applied to agricultural soils. These metals are lead (Pb), cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), nickel (Ni) and zinc (Zn). Biosolid, however, are rich in organic matter and nutrients, and the recycling through application of biosolid to agricultural land has been promoted as a means of avoiding the environmental and economic costs of disposal (Bright and Healy, 2003). The organic matter in biosolid improves the soils structure, increases its water holding capacity, and feeds essential soil microorganisms. The most prominent concern is the presence of heavy metals and therapeutic agents in the biosolid and the affect they will have on the environment surrounding the application site and how they will be incorporated into the food chain (Jjemba, 2002). Addition of compost to soil increased organic matter, N, P and K content of soil (Benedek et al., 2012).

Excessive biosolid application may lead to a reduction in crop yields due to plant nutrient deficiency and/or imbalances. Also excessive application contributes to a range of environmental problems including the nitrification of ground water systems (Cooke et al., 2001).

The high concentration of heavy metals in soils is reflected by higher concentrations of metals in plants, and consequently in animal and human bodies. The ability of some plants to absorb and accumulate xenobiotics makes them useful as indicators of environmental pollution (Buszewski et al., 2000).

MATERIALS AND METHODS

Sewage sludge material was collected from domestic wastewater treatment plant in Nyíregyháza city, sample was aerobically digested and sand bed-dried. The chemical characteristic analyses are mentioned in Table (2).

Table (2) Physical and chemical analysis of used sewage sludge

Characteristic parameter		Sewage sludge
$PH_{(KCl)}$		6.71
Content of solid matter (%)		68.4
Total nitrogen (mg/kg)	*MSZ 318-18:1981*	2150
Total phosphorus (mg/kg)	*MSZ 318-19:1981*	20140
Total iron (mg/kg)	*MSZ 08-0012–16:1987*	13610
Cadmium (mg/kg)	*MSZ 318-21:1983*	0.5
Calcium (mg/kg)	*MSZ 08-0012–14:1987*	12200
Total chromium (mg/kg)	*MSZ 318-11:1983*	37.03
Copper (mg/kg)	*MSZ 08-0012–19:1987*	93.3
Lead (mg/kg)	*MSZ 318-10:1985*	102.2

Manganese (mg/kg)	*MSZ 08-0012–17:1987*	212.5
Magnesium (mg/kg)	*MSZ 08-0012–15:1987*	3500.4
Nickel (mg/kg)	*MSZ 318-7:1983*	25.7
Potassium (mg/kg)	*MSZ 08-0012–11:1987*	2908
Zinc (mg/kg)	*MSZ 08-0012–12:1987*	1068

The experimental preparation of soil-sludge mixture in two-kg pot capacity, to form homogenous agro-ecosystem for plant growth was formed according to the following mixture: Soil of clay loam brown forest originated from Gödöllő and sewage sludge of Nyíregyháza, Hungary were mixed with following the ratios: 100:0, 70:30, 50:50, 30:70 and 0:100% soil:sludge ratios.

Greenhouse conditions

The plant-soil-sludge agro-ecosystem was conducted in greenhouse under automatically setup conditions to be consisted of a 12 h day maintained with two paired day-light and warm white fluorescent tubes at 10000 lux, day-time temperatures of 22°C, and night temperatures of 16°C. The experimental pots were watered as necessary to maintain the soil moisture content at approximately 60±2% field capacity.

Test plants common bean (*Phaseolus vulgaris* L.) and spring wheat (*Triticum aestivum* L.) were cultivated in westsik sandy soil originated from Nyíregyháza and treated with sewage sludge of Nyíregyháza. Plant cultivation was carried out for 50 days, than the plants were carefully uprooted. Roots were thoroughly washed with light tap water for 2-5 minute to remove all loosely adhering soil particles followed by washing with sterile 0.85% saline Milli Q water. The roots were cut sharply. Plants were carefully uprooted, after root length measurements, the root macerated in sterile 0.85% saline Milli Q water with a sterile mortar and paste. The samples were shaken horizontally with 150 rpm for ½ h in shaker machine. Serial dilution technique was carried out for all samples of soil-bisolid cultivation agro-ecosystem in sterile distilled water. The 10^4, 10^5, 10^6 and 10^7 dilutions were used for further investigations. All investigations were carried out in the greenhouse of Soil Science and Agrochemistry as well as the Central Laboratory of Szent István University, Gödöllő, Hungary.

Determination of total soluble heavy metal content in soil: According to the Hungarian Standard MSZ 21470-50/1998, the standard describes the procedure for determination of total heavy metal content in soil which can be digested in microwave assisted nitric acid (HNO_3) / hydrogen peroxide (H_2O_2) extraction / digestion by atomic spectroscopic methods.

Sample preparation by microwave assisted extraction/digestion with (HNO_3)/(H_2O_2) mixture: 0.5 grams of air-dried and homogenized soil was weighed in vessel of a MILESTONE 1200 MEGA microwave oven. Five ml of *aqua-regia* (HNO_3 (67%) and 2 ml of H_2O_2 (30%)) was added. The microwave digestion program for soil samples was as it follows: 5 min, 250 W, 2 min 0 W (cooling), 5 min, 400 W, 5 min, 250 W, 7 min, 700 W, 5 min, 0 W (cooling). The solution was filtrated on Macherey-Nagel G 1/4 filter paper and diluted to 25 ml.

Element analysis by ICP-AES: In the extracts made by the Hungarian standard procedures the following elements were determined with Jobin-Yvon JY-24 of sequent ICP-AES instrument: (Cu, Fe, Zn, Pb, and Cd). Additionally, the following metals were measured at the following wavelengths: **Pb** (220.313 nm), **Cu (**324.754 nm), **Fe** (238.209 nm), **Cd** (228.802 nm) and **Zn** (213.856 nm).

Sample preparation by ashing and HNO_3 dissolution of plant samples: Two grams of air-dried and homogenized plant sample was weighed into porcelain crucible. The sample was carefully ashed on 500°C. After cooling the residual was taken up with 67% HNO_3 and was quantitatively brought in 25 ml flask. The same conditions were done by Jobin-Yvon JY-24 of sequent ICP-AES method as described.

All tests were carried out at least in triplicates. Group differences across metric dependent variables based on set of categorical (non-metric) variables were assessed by multiple analyses of variance (MANOVA). Differences in means were evaluated by F-probe according to Sváb (1981). Excel 5.0 statistical functions were used for calculations and graphic presentation of data. Standard deviation (SD) and Least Significant Difference at 5% level ($LSD_{0.05}$) were calculated as well. Statistical interpretation was made by reference to Sváb (1973, 1979).

RESULTS

Effect of sewage sludge application on the Fe, Zn content in the plant grown in treated soil: The Fe contents in the roots of spring wheat and field growing common bean plant were more than the Fe contents detected in shoots of the both plants. Fig. (1) shows there were no significant differences within the applied doses 0, 30, 50 and 70% sludge content in the experimental models of spring wheat, but it was significant between all these doses and 100% regarding the amount of Fe content.

The Fe contents in the roots of common bean were more than 2 x higher than the amounts of Fe in those detected in the roots of spring wheat at all concentrations of applied sewage sludge containing in the model of growth medium (Fig. 2). There was a significant difference between the amount of Fe in the roots of common bean grown at 50, 70, and 100 and those of detected at 0 and 30%. But in the case of shoot, alteration was found only between the plants grown at 100% sludge and control.

The results showed that by increase the application dose of sewage sludge in the soil cause an increasing in the amount of Zn in the shoots and roots of spring wheat and common bean. Also, the amounts of Zn content in common bean were higher than those amounts detected in spring wheat by at least 1.5 times. The Zn content in the roots of spring wheat was less than the amount present in the root of field growing common bean (Figs. 3 and 4, respectively), while it was higher in shoot than in roots of common bean (Fig. 4).

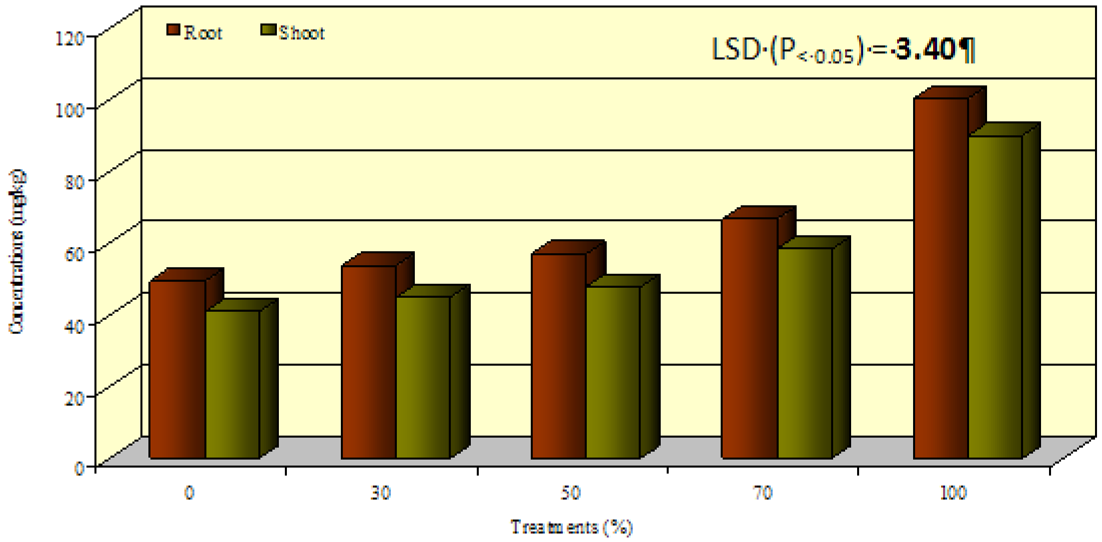

Figure (1) Effect of different application rates of sewage sludge on ion content in shoot and root parts of spring wheat

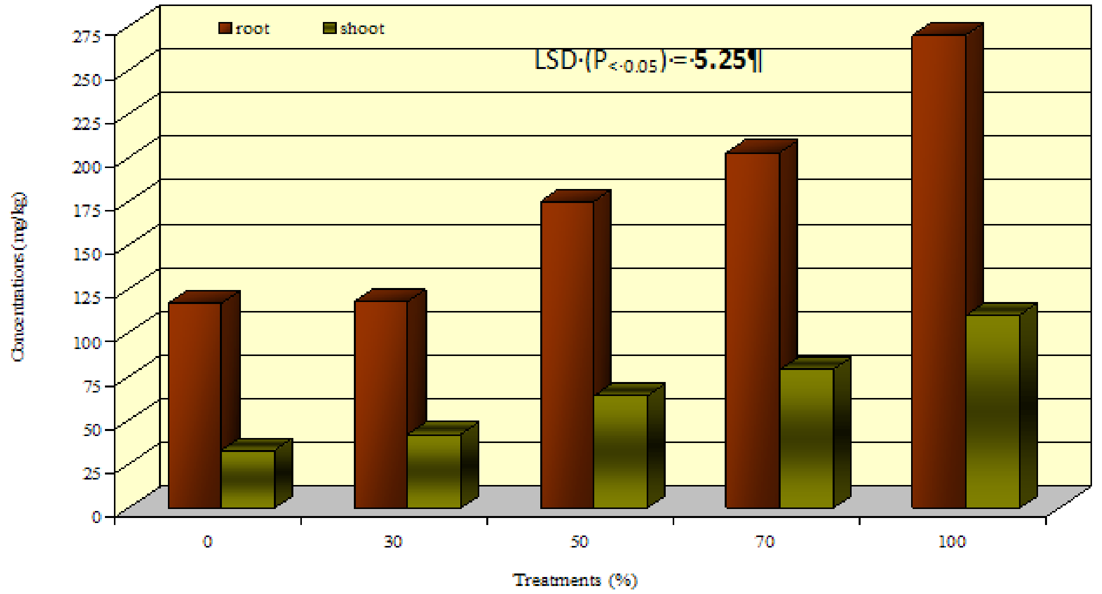

Figure (2) Effect of different application rates of sewage sludge on ion content in shoot and root parts of common bean plants

Significant differences were obtained within the concentrations of the sludge in the growth medium for both plants. The maximum amounts of Zn detected in spring wheat and common bean were found in shoots by 15 and 28 mg/kg, respectively.

Effect of sewage sludge application on the Cd, Pb and Cu content in the plant grown in treated soil: The amount of Cd uptake by spring wheat was found to be higher than uptake by common bean plants (Figs. 5 and 6, respectively). Meanwhile, the uptake amounts of Cd in roots of both plants were less than 0.2 mg/kg. The uptake of Cd was found to be increased by increasing the sludge doses in soil. There was a significant difference between the Cd up take and the applied sludge doses and among the amounts taken up by the plants, as well. The maximum amount of Cd detected in the roots of spring wheat was 0.006 mg/kg, while it was 0.016 mg/kg in common bean.

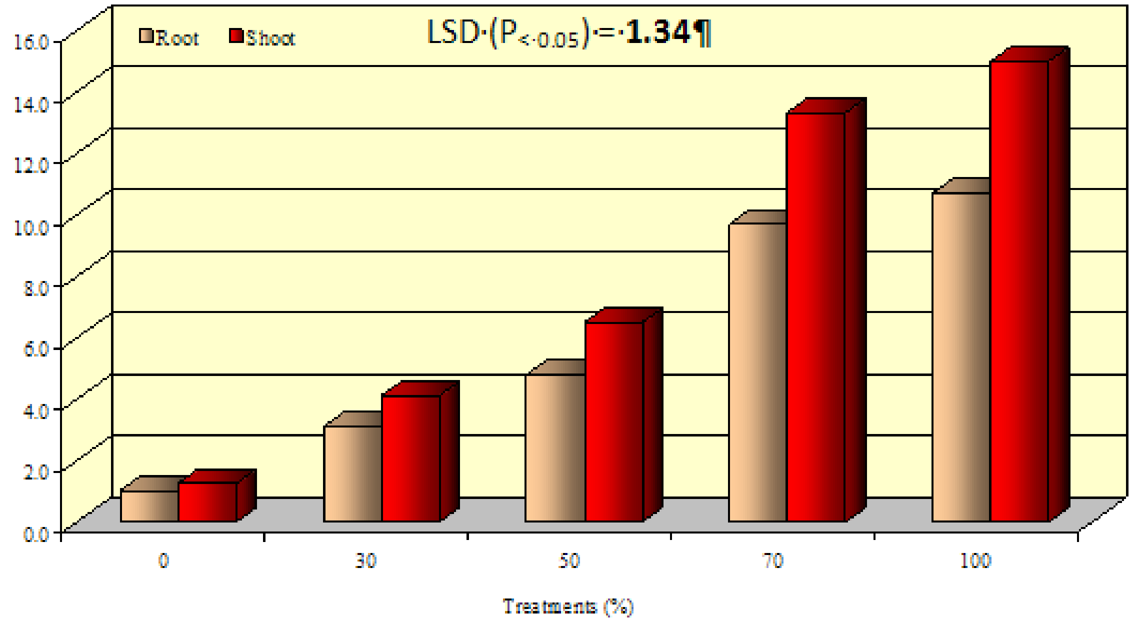

Figure (3) Effect of different application rates of sewage sludge on zinc content in shoot and root parts of spring wheat

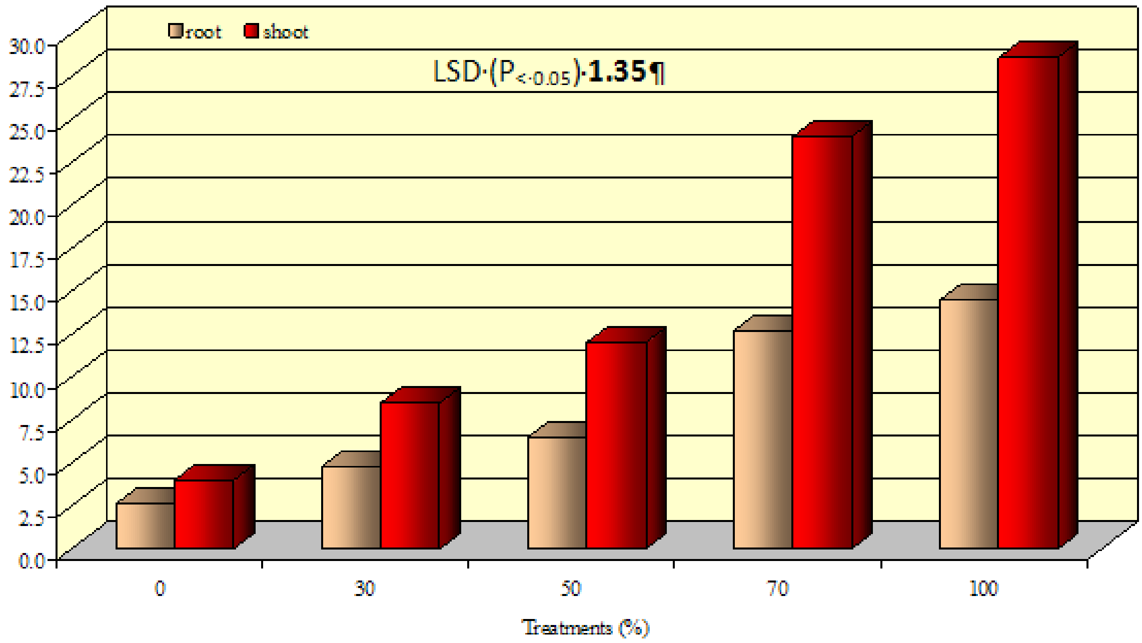

Figure (4) Effect of different application rates of sewage sludge on zinc content in shoot and root parts of common bean plants

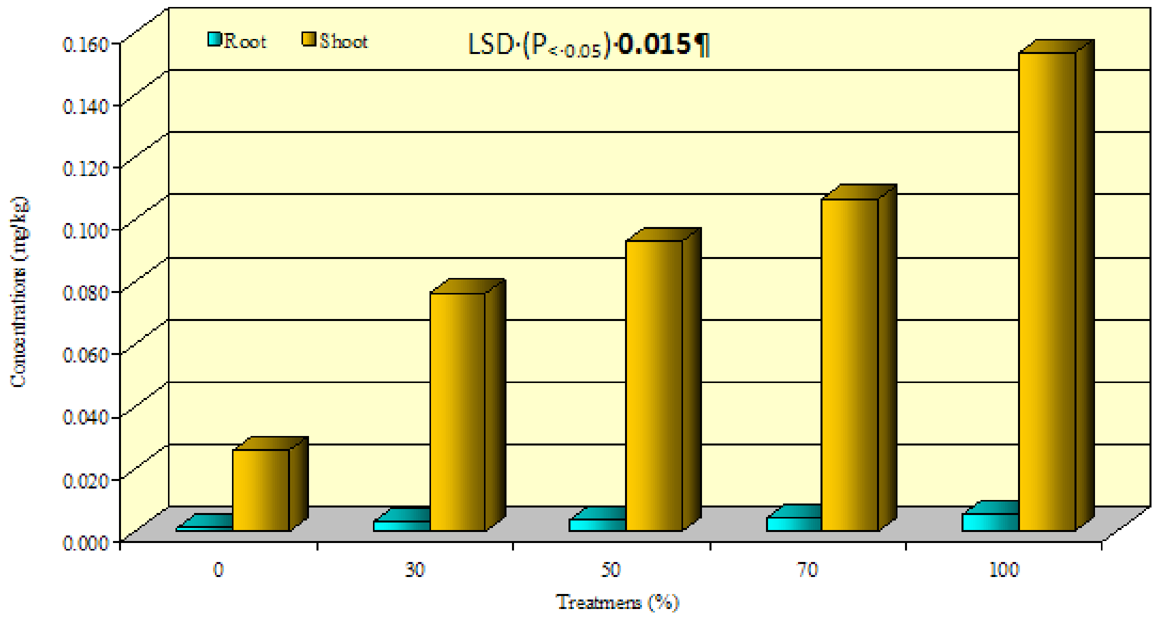

Figure (5) Effect of different application rates of sewage sludge on cadmium content in shoot and root parts of spring wheat

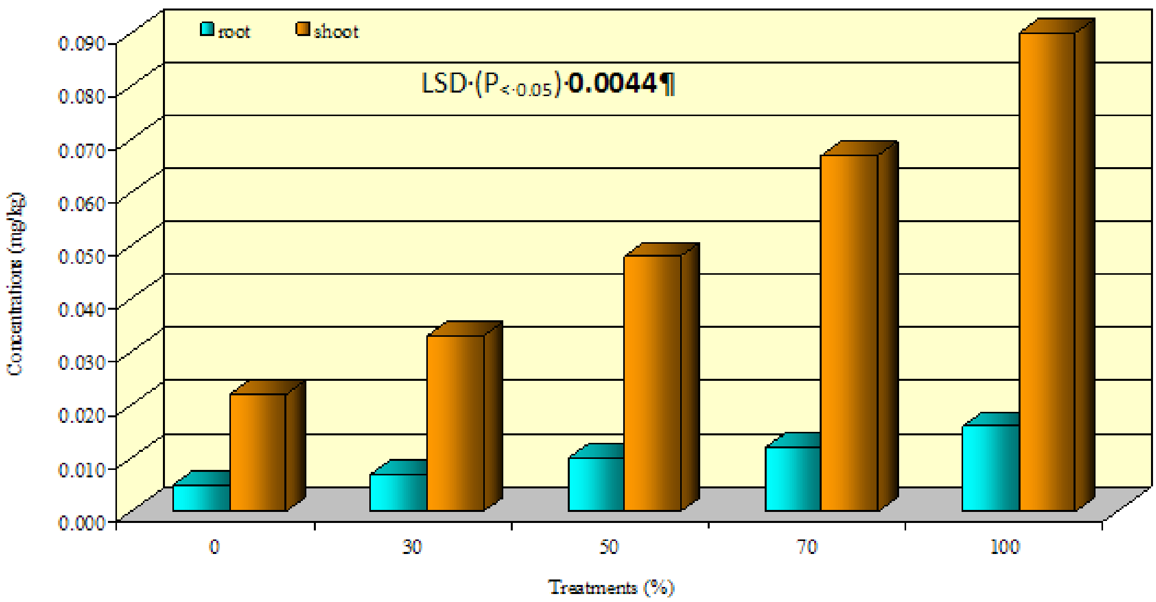

Figure (6) Effect of different application rates of sewage sludge on cadmium content in shoot and root parts of common bean plants

However, the uptake of Pb by the root system in the spring wheat was higher than the uptake amounts by shoots (Fig. 7). The maximum amount of Pb detected in roots was 0.56 mg/kg, and in shoot, it was 0.383 mg/kg. While in the case of common bean, the uptake of Pb was lower than the amount uptake by shoot system (Fig. 8). The results illustrated that the amount of Pb uptake by shoot in common bean were more than 7 x the amount of uptake by shoot of spring wheat at 50% sludge contained in the models and 4 x at 100%.

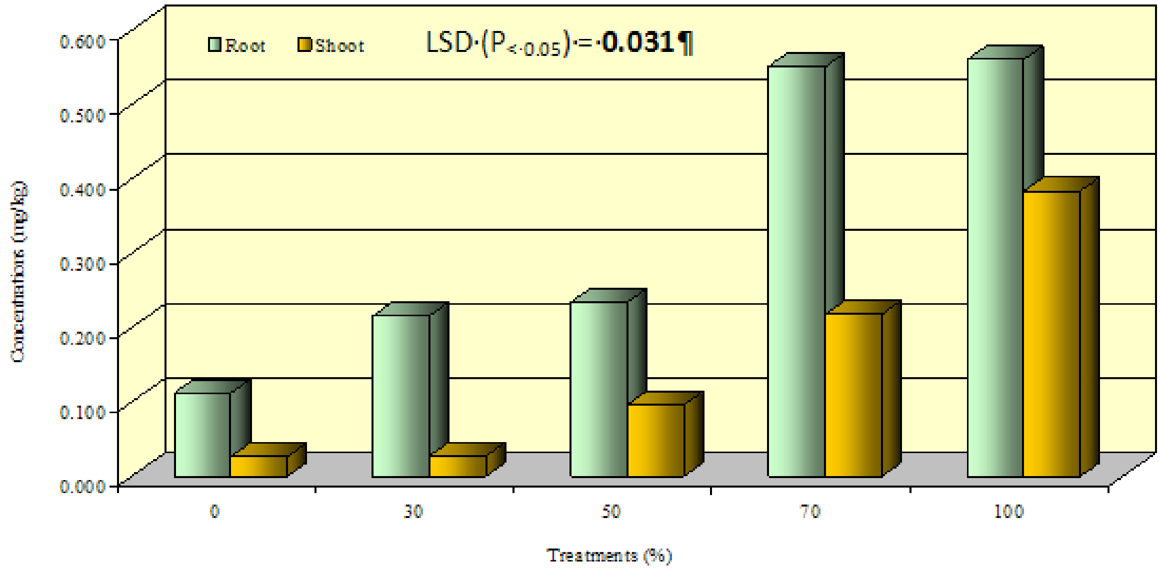

Figure (7) Effect of different application rates of sewage sludge on lead content in shoot and root parts of spring wheat

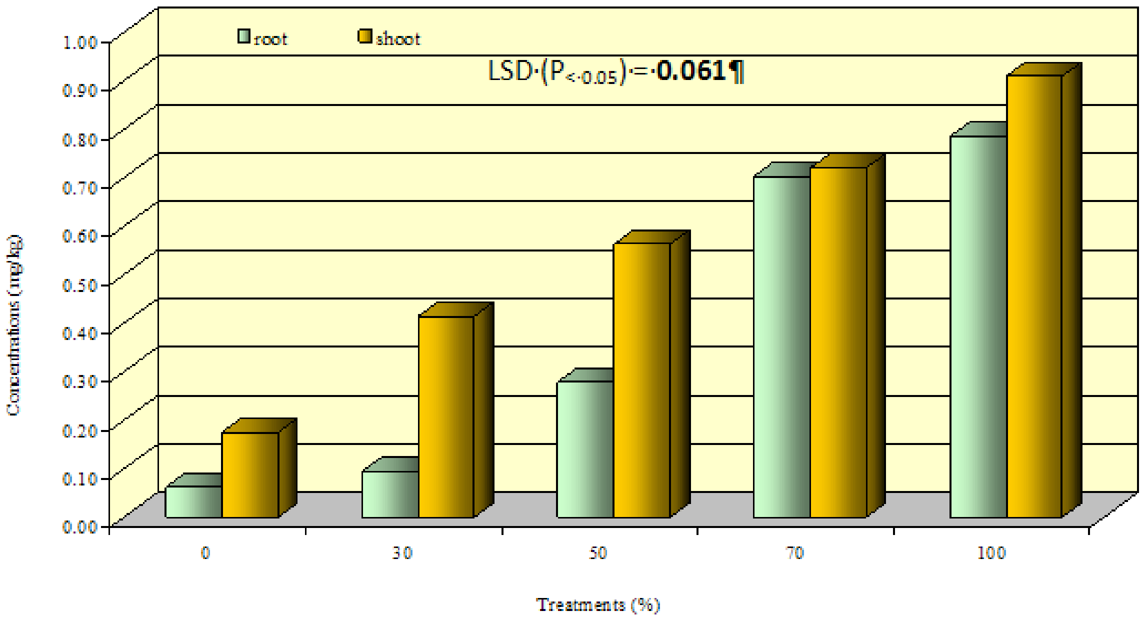

Figure (8) Effect of different application rates of sewage sludge on lead content in shoot and root parts of common bean plants

Statistically, it was found that the amount of Pb uptake by root at 70% and 100% sludge containing medium is significant compared to the uptakes at 0, 30 and 50% sludge containing soil for spring wheat. But in the case of common bean, it was significant within all applied doses of sludge. The maximum amount of Pb uptake was less than 0.6 mg/kg in spring wheat grown at 100% growth medium containing sludge. When the common bean plant grew in medium containing 100% sludge, the maximum amount of Pb uptake in shoot tissues was 1.47 mg/kg, and at the same time, the amount of Pb uptake by root at this concentration was nearly 0.79 mg/kg. Figs. 9 and 10. demonstrate the amount of Cu uptake by spring wheat and common bean respectively. Maximum amount of Cu uptake at 100% sludge containing system by spring wheat and detected in the shoot was nearly 0.071 mg/kg, while the amount found in the root was about 0.037 mg/kg.

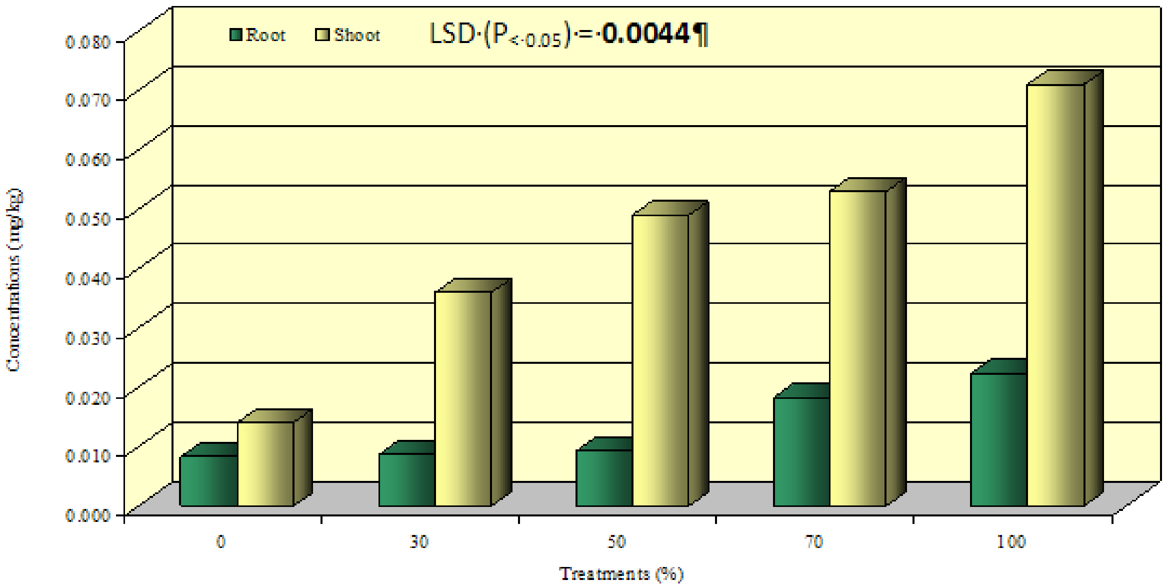

Figure (9) Effect of different application rates of sewage sludge on copper content in shoot and root parts of spring wheat

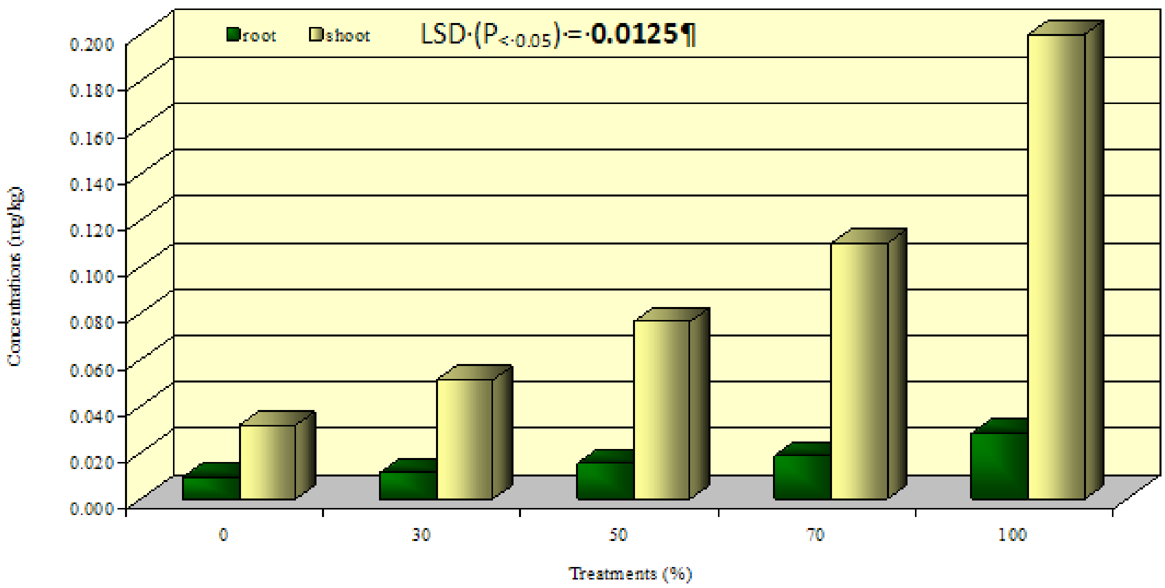

Figure (10) Effect of different application rates of sewage sludge on copper content in shoot and root parts of common bean plants

The maximum amount of Cu uptake by the root of spring wheat was detected at 50% sludge containing medium, which was about 0.027 mg/kg. In the case of field growing common bean plants, it was found that there were no significant differences among the amount of Cu uptake by roots of various media containing different rates of sludge, while there were significant differences between the amount of Cu in the shoot and the applied doses of sludge in each particular medium (Fig. 10). Maximum amount of Cu detected in common bean was detected at 100% and it was 0.200 mg/kg and in root, it was 0.028 mg/kg.

DISCUSSION

Akrivos (2000), Zhang et al. (2000) and Lau et al. (2001) mentioned that with the increasingly growing global production of sewage sludge, evaluation of its applicability in agriculture and land restoration is essential. This study assessed the potential effects of composting process and fly ash amendment on soil-ameliorating properties of sewage sludge. The metal availability and phytotoxicity of ash-amended sludge compost and sludge-ash co-compost were compared. The results of this work suggested that both composts favoured the applicability of sewage sludge for land application by reducing Cd, Cu, Pb, and Zn availability. HENNING et al. (2001) showed that application of sludge to different soils could be useful in order to increase crop growth over a 28-day period in the glasshouse. Rezaenejad and Afyuni (2001) found that cow manure and sewage sludge have high fertiliser values, which led to heavy metal concentrations in the soil as well as in maize tissues which were much lower than the reported standards. Similarly, our detection to Cd, Pb, and Cu in the plant tissues of spring wheat and common bean showed that the level of the detectable metals were lower than the standard. The detected values of the Cd, Cu, and Pb were at 100% sludge containing medium 0.153, 0.071, and 0.383 in the shoots of spring wheat, respectively. While in common bean, they were 0.090, 0.200, and 1.47, respectively. While the detected values of these metals in root were highly lower except in the case of Pb in the roots of spring wheat. Similar observation was obtained by Lavado et al. (2001) who mentioned that heavy metals concentration were higher, with the exceptions of Cd, in roots than grains in wheat, maize and soybean crops when analysed for Cd, Cu and Pb. Zhang et al. (2000) measured various crop responses to mixed municipal solid waste-biosolids compost and examine the fate of certain metals associated with compost soil and plant samples were analysed for nutrient content such as Cu, Cd and Pb. The results showed that the compost slightly increased heavy metal concentrations in the soil but did not cause any phytotoxicity to crops. Our experimental data indicated similar observation of Zhang et al. (2000).

Jorhem et al. (2001) examined wheat flour, wheat bran and rye flour annually in several different areas in Sweden for 15 consecutive years (1983-1997) for a total of 105, 90 and 30 samples, respectively. These samples were analysed for their content of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn by atomic absorption spectrophotometry with background correction after dry ashing at 450°C. As part of the quality control procedures, an in-house reference material was analysed in parallel to the samples to ensure reliability of the results. In addition, a certified reference material was analysed to monitor accuracy of the results. The Cd level in wheat and rye flours (mean 0.029 and 0.017 mg/kg dry wt, respectively) correlated significantly with time ($P < 0.05$) in 2 phases, tending to increase during the first half of the period and decrease during the latter half. In wheat bran, Cd (mean 0.15 mg/kg) levels did not correlate significantly with time. Similarly, we obtained the following results at 100% sludge containing medium the mean 0.0057 mg/kg Cd in spring wheat, while it was 0.153 in the shoot. At the same sludge concentration, the results were 0.016 mg/kg Cd in the roots of common bean, while it was 0.090 mg/kg in the shoots.

Benitez et al (2001) stated that treatments including organic biosolids increased Cu and Zn concentrations in wheat roots, straw and grain, whereas the addition of biosolids-ash did not affect the concentrations of these metals in wheat. Concentrations of Ni, Co, Pb, Cr and Cd in wheat were below reliable detection limits (0.06, 0.05, 0.1, 0.06 and 0.02 mg kg^{-1}, respectively). Also, total Cr increased only in treatments including organic biosolids. We found that the Cu, Cd, and Pb content in the roots of spring wheat were 0.028, 0.016, and 0.79, respectively at 100% sludge model system.

Tamoutsidis et al. (2002) mentioned that after sewage sludge application, edible plant parts of leaf and root vegetables had increased Cu and Zn concentrations, whereas Fe concentrations remained almost unchanged in the leaf vegetables and were lower in the root vegetables. Zhang et al. (2000) and Lavado et al. (2001) studied the effect of conventional and zero tillage on the concentration of micronutrients and specially heavy metals and their distribution in soybean, wheat and maize plants in an area located far from contamination sources. Plants were sampled in 1997 and separated into roots, aboveground material and grains. The Wheat, maize and soybean crops were analysed for Zn. Micronutrients and heavy metals concentration were higher, with the exceptions of Cd, in roots than grains (i.e. Zn in soybean grains, 44.85 mg kg^{-1}; roots, 64.73 mg kg^{-1}). The effects of tillage were limited for nutrient concentrations, but significant for heavy metals. Soybean appeared to be more sensitive than cereals to the apparent effect of soil tillage. Regarding to our results, it was found that by growing spring wheat and common bean in westsik sandy soil mixed with different rates of sewage sludge, the amounts of Zn in the shoots of common bean approximately were the double amounts detected in the shoots of spring wheat. Also, the amounts of Zn present in the roots of common bean were higher than the amounts in the roots of spring wheat. But, regarding to the Fe concentrations, it was found that our experimental data showed the concentrations in the roots of both plants were higher than the amount detected in the aerial parts.

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ASSESSMENT OF THE EFFECTIVENESS OF ACOUSTIC NOISE MEASURES FOR VACUUM CLEANERS

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Abstract: *Noise reduction of home appliances is an important part in the development process of new products and their parts. Vacuum cleaners are one of the equipment in the household that produce noise. Noise is factor that can affect human health. Producer due this reason reduce their noise. Noise reduction of the products also provides competitive advantage for the producers. Development of new products and their parts is necessary to realize assessment of effectiveness anti noise measures.*

Keywords: *noise, measure, vacuum cleaners, assessment*

INTRODUCTION

Primarily in living environment sound perception is more intense, so when you purchase your home appliances plays an important role the noise emitted by the appliance. In this regard, the manufacturers try to ensure that their products are the quietest and therefore design and applied various noise measures to their products.
Due to the efforts of producers and users requirements concerning the noise of home appliances can be considered the issue of application of noise measures treatments and monitoring their effectiveness and efficiency is very important and actually.
The loudest appliances in households are vacuum cleaners, and therefore the noise emitted by the vacuum cleaners is often subject of the interests of producers and their efforts to reduce the overall noise level.

EXPERIMENTAL MEASUREMENTS

There are two main sources of the noise in the vacuum cleaners:

- Noise emitted by the engine and their elements,
- Noise produced by the airflow through the suction nozzle and hose.

Subject of the measurements is vacuum cleaner Zelmer Explorer 1100.0. It is regular household vacuum cleaner intended for all kinds of the surfaces with changeable nozzles.
During the experimental measurements were compared two types of vacuum nozzle. For measurement was used vacuum cleaner Zelmer Explorer 1100.0 (fig. 1). For comparison was taken two vacuum nozzles, classic nozzle and turbo nozzle with applied acoustic measures (material, design, and construction). Producers declare identical effectiveness of the suction process.

Figure 2: Vacuum cleaner Zelmer 1100.0

Classic vacuum nozzle (fig. 2) is intended for carpets and smooth surfaces. To this nozzle belongs one row of bristles, wheels and top plastic cover and bottom metal part.

Figure 3: Classic nozzle

Turbo-nozzle (fig. 3) is added mechanical rotary valve with bristle for better effectiveness of the cleaning. Ejection of this valve is possible to set up. Rotation of this valve is secured by the airflow. All other parts of the nozzle are plastic materials.

Figure 4: Turbo- nozzle

Measurements was executed on the two different surfaces: carpet and wooden floor. There was simulated two different conditions: vacuum nozzle stucked on the cover and vacuum nozzle with free placement over the cover that better simulate real conditions of vacuum cleaning. Free placement was secured by the dilatation elements placed under the nozzle.
During the measurements was secured identical conditions:

- Power of the vacuum cleaner was set to 75 %,
- Setting the nozzles and placement of the vacuum cleaner.

Measurements were realized by the classic sound analyser and by the acoustic camera – tool for dynamic noise visualisations. [2]
First set of the measurement was realized with acoustic camera set upright to nozzle.
Second set of the measurements was realized with acoustic camera set above nozzle. Measurements set up is shown in the fig. 4.

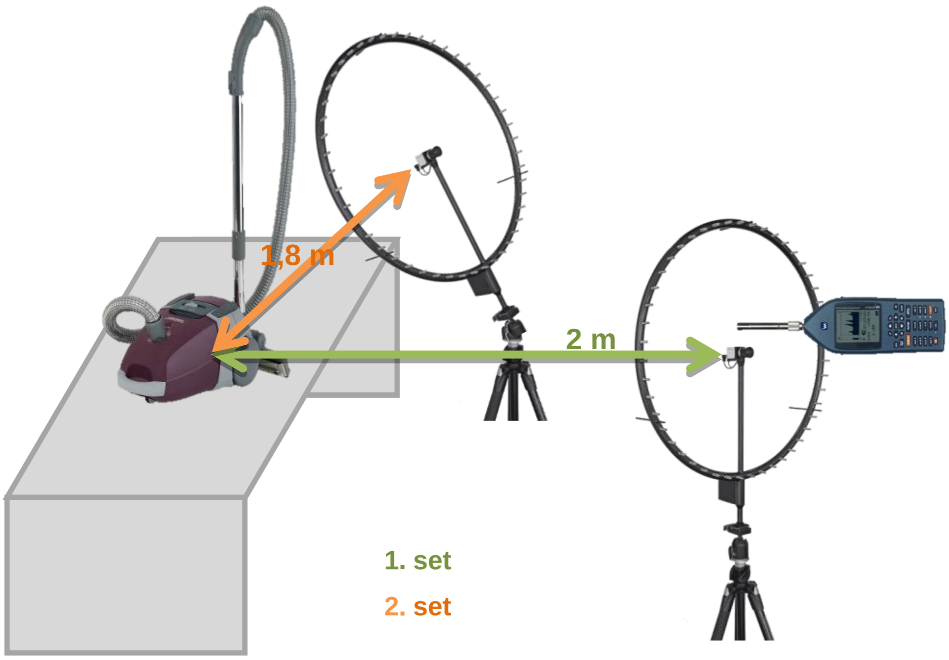


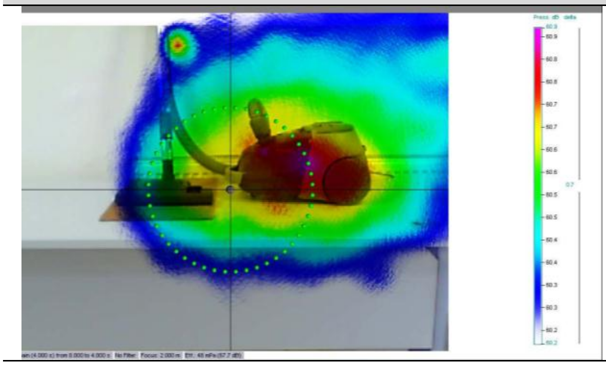
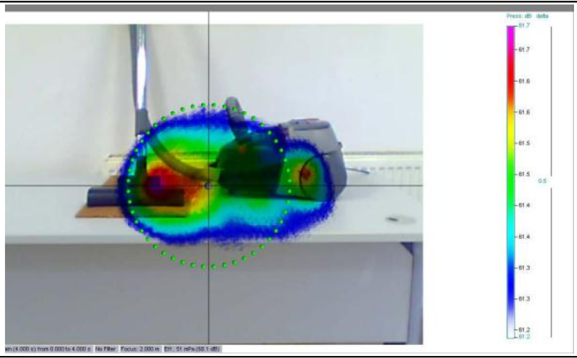
Figure 5: Set up of the measurements

Realized measurements:
- Measurement 1 – nozzle free placement on the carpet
- Measurement 2 – nozzle stucked on the carpet
- Measurement 3 – nozzle free placement on the wooden floor
- Measurement 4 – nozzle stucked on the wooden floor
- Measurement 5 – nozzle stucked on the wooden floor – top view
- Measurement 6 – nozzle stucked on the carpet – top view

RESULTS OF THE MEASUREMENTS

Noise visualization

Next figures presents noise emissions emitted by the nozzles and vacuum cleaner in different measurements conditions. Presented are only selected characteristic results (fig. 5).

Classic nozzle	***Turbo-nozzle***
	
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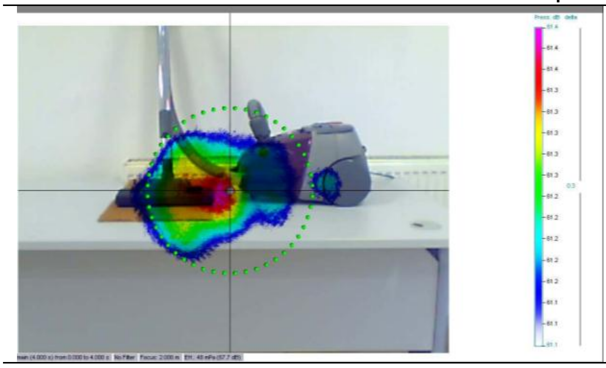	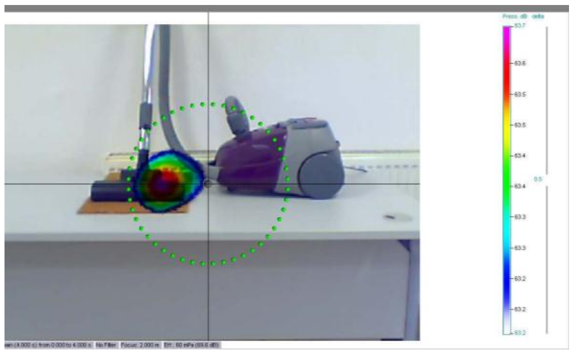
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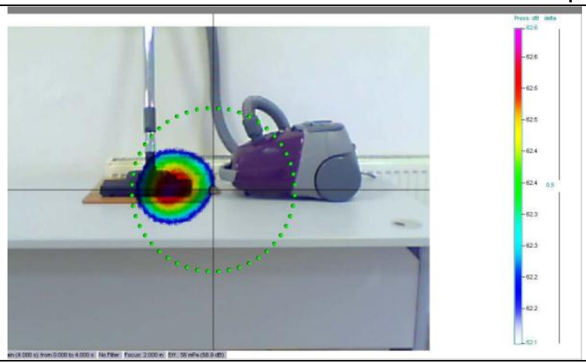
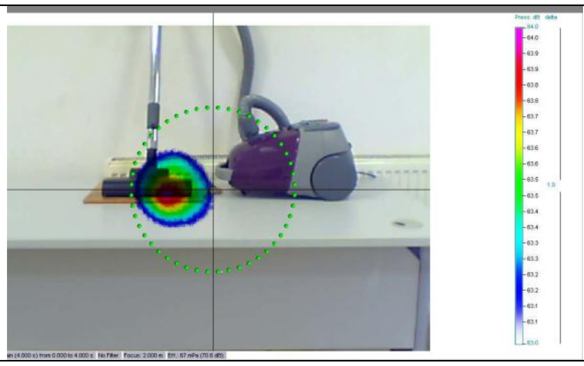
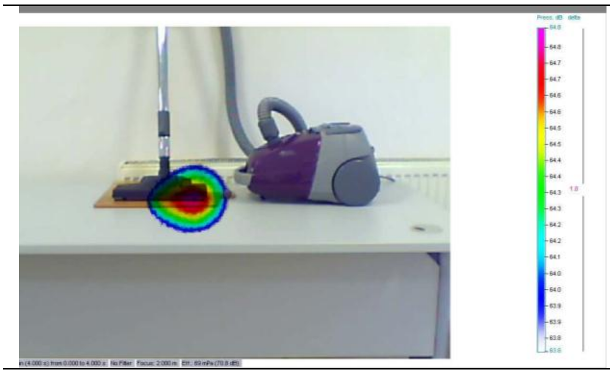
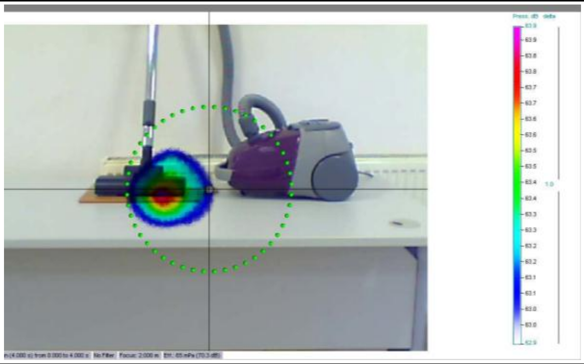
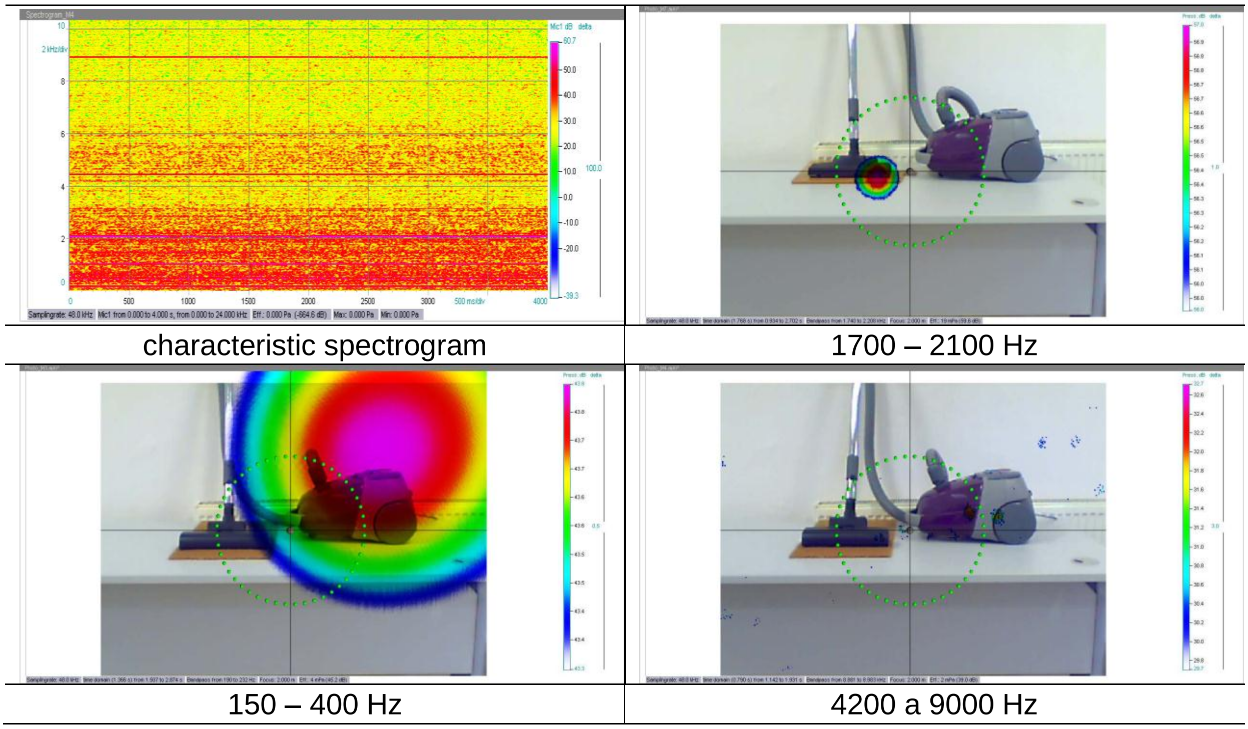
	
wooden floor / stucked	
	
wooden floor / free	

Figure 6: Results of the measurements by the acoustic camera

Next figures present dominant frequencies that were found out during the measurements with both nozzles and on the both measured surfaces.



characteristic spectrogram | 1700 – 2100 Hz

150 – 400 Hz | 4200 a 9000 Hz

Figure 7: Visualization of the dominant frequencies

Results of the measurement by the sound analyser

Result of the measurement of sound acoustic pressure by the sound analyser is presented in table. 1. Measurements were realized in one time together with noise visualization measurements. [1]

Table 1: Results of the measurement by the sound analyser

Surface	Nozzle placement	Classic nozzle		Turbo-nozzle	
		$L_{Aeq,T}$ [dB]	L_{Cpk} [dB]	$L_{Aeq,T}$ [dB]	L_{Cpk} [dB]
carpet	free	63,6	77,3	63,8	78,3
	stucked	62,8	77,3	66,3	82,2
Wooden floor	free	65,4	79,8	67,6	80,7
	stucked	68,3	80,9	68,7	85,2

VALUATION AND OVERVIEW OF THE MEASUREMENTS

On the base of measurement results by the sound analyser and acoustic camera results shown that noise emitted by the turbo nozzle is little higher than classic nozzle. Differences in the noise level was in the range 0.2 – 3,5 dB. We expect that these differences are caused mainly by the rotation valve with bristle.

During the measurements on the wooden floor was measured higher level of noise with stucked nozzles, due the reason of increased power of vacuum cleaner engine and also by the airflow. Between the nozzle and surfaces is formatted thin slot for airflow and this effect cause the increase of noise level.
By the analyzing the acoustic pictures was found out:

- Dominant noise source of vacuum cleaner is nozzle in case of free placement nozzle on the surface – formation of thin slot between surface and nozzle,
- Dominant noise source of the vacuum cleaner is engine in case of stucked nozzle – increased power of the engine,
- Dominant frequencies caused by the airflow are in the range 480 – 600 Hz and 1700 – 2000 Hz,
- Dominant frequencies caused by the engine are in the range 200 – 600 Hz,
- During the measurement was found out the frequencies in the range 8900 – 9000 Hz, we expect that it is caused by the carbon elements in the engine.

CONCLUSION

During the measurement was compared two nozzles, classic a and turbo-nozzle with applied acoustic measures. By the measurement and analyzing was found out that overall level of noise is higher for turbo-nozzle despite realized acoustic measures, but difference was so close. Important factor is that turbo-nozzle is equipped by the rotary valve with bristle. In case that acoustic measures was not realized we expect that difference in noise level should by higher and effectiveness of acoustic measure was sufficient. For the accurate assessment should be better comparison of two identical nozzles.

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A FUTURE CHALLENGE FOR ENVIRONMENTAL MANAGEMENT: RAISING ENERGY EFFICIENCY IN THE WATER UTILITIES SECTOR

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Abstract: *Water supply and sewage treatment costs are steadily rising, and service providers are engaged in a constant battle with local authorities for acceptance of higher charges. Consumers find it hard to pay the charges, which often increase at a higher rate than their incomes. To limit charge increases, the water utilities put a priority on optimising energy use in water extraction and supply and in sewage treatment Water supply equipment and sewage pumps are designed for maximum capacity, but recently there has been a perceptible decrease in water consumption and this reduces capacity utilisation. The problem demands a new, horizontal approach, appraising the whole process of water movement – covering wells, reservoirs, process pumps and supply pumps – and optimising overall energy consumption. In the test operation, the planned monthly saving of 15,000 kWh was attained by the third month of 2010 and surpassed by the end of the year. The new control system resulted in saving of 25-40% when applied at the waterworks. Security of water supply has not been jeopardised by the introduction of energy-efficient operation*

Keywords: *Energy efficiency, cost reduction environmental management, environmental load reduction, water utilities sector, pumps*

INTRODUCTION

The initial study involved a series of tests at water utility companies, and the results prompted the implementation of an energy-efficiency project. This paper presents observations from the project's first three years.

Water supply and sewage treatment costs are steadily rising, and service providers are engaged in a constant battle with local authorities for acceptance of higher charges. Consumers find it hard to pay the charges, which often increase at a higher rate than their incomes.

To limit charge increases, the water utilities put a priority on optimising energy use in water extraction and supply and in sewage treatment. The utilities approach this aim in several ways. One of these is to reduce the rate of unrelenting electricity price increases through agreements with electricity suppliers.

Water supply equipment and sewage pumps are designed for maximum capacity, but recently there has been a perceptible decrease in water consumption and this reduces capacity utilisation.

The problem demands a new, horizontal approach, appraising the whole process of water movement – covering wells, reservoirs, process pumps and supply pumps – and optimising overall energy consumption. This involves incorporating the characteristics of every element of the water supply into the regulation of pumps, so that the pumps operate in the optimum energetic state – as far as possible – at all times.

TEST MEASUREMENTS

In March 2010, we carried out test measurements at three Hungarian water utilities to assess the opportunities for making savings. Overall, we found possible savings of 740,000 kWh per annum, equivalent to HUF 22,000,000, an average of 21%.
Measurements at sewage pumps showed that the savings attainable there were at least as high as in the water supply, and in some cases higher. This finding is borne out by measurements in other countries.
Further tests were carried out in 2011. The attainable savings are compared in Figure 3.
The measurements covered the wells and pumping stations of each waterworks. The quantity of water produced was taken into account in the calculation of savings.

PILOT PROJECT

In Hungary, the first implementation was at the water utility company Dombóvár és Környéke Víz és Csatornamű Kft in late 2009.
The company operates water wells, filtration plants and booster pumps. The tests showed potential savings of between 15 and 55% at different pumps.
The figures for energy saving attained were as follows:
In the test operation, the planned monthly saving of 15,000 kWh was attained by the third month of 2010 and surpassed by the end of the year. What raised the savings above the planned level was the commissioning and putting into service of three new wells during the year. These replaced old, less efficient wells and their operation was optimised for energy use. The new regulation system resulted in saving of 40% when applied at number IV water-works and 25% at number V water-works.

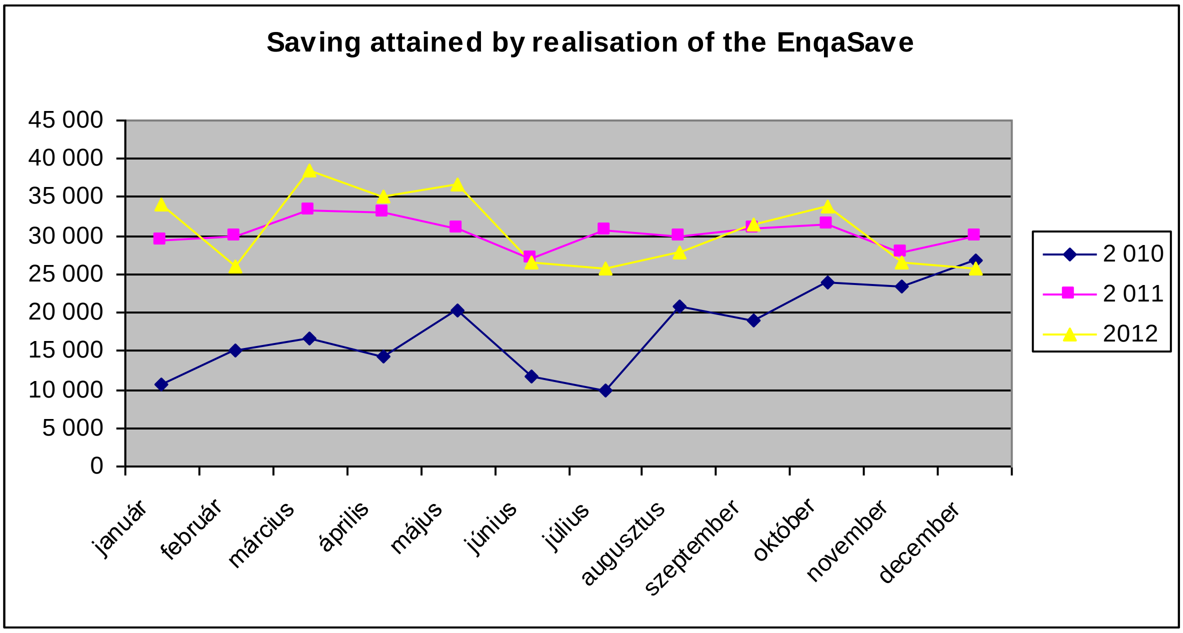

Figure 1: Energy savings by realisation of the EnquaSave in kWh (Dombóvár Water-works)

The great benefit of energy-saving developments is that their cost can be repaid out of the savings. Experience shows such developments show a return after 3-4 years, depending on the installation.
Important:

1. Security of water supply has not been jeopardised by the introduction of energy-efficient operation
2. There has been no change in water quality

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THE APPLICATION OF LYOPHILISATION TECHNOLOGY FOR ISOLATION OF NATURAL SUBSTANCES

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Abstract: *The natural components (anthocyanins) of plant origin in order to therapeutically properties have own advantages in a compare with chemically synthezised. With regard to general isolation of these components (secondary metabolites of plants, animals and other organisms) the distillation and extraction methods are used. The method of freeze drying is totally different against distillation or extraction technologies. The aim of research and development is the optimization of anthocyanin lyophilization process from acetone extracts of the Northern high bush blueberry (Vaccinium corymbosum L.) fruits. The acetate extracts were supplied in a frozen condition. The solvent - acetone was vacuum-evaporated after extraction from all samples. The device GEA Lyophil SMART LYO 2 from the German producer GEA was used for the lyophilization. The work consists of two parts: optimally diluted samples by purified water after defrosting and optimization of the lyophilization program in a way to achieve the final product in the form of a dry powder at the end of the process. The basic research in its various stages of this process confirmed that by the method of freeze-drying can be isolated natural substances (anthocyanins) after extraction from plant material with their stabilization and their biological activity.*

Keywords: *Anthocyanins, Blueberry, Extract, Fruits, Lyophilization.*

INTRODUCTION

Within the general separation of natural compounds (secondary metabolites of plants, animals and other organisms) distillation methods are used (hydro distillation or water vapour), which resulted in the extraction of volatile oils and extracts, where we get liquid and dry extracts. In both methods are used different types of solvents and higher temperature, which directly affects the stability and frequent breakdown of some sensitive natural components. In regard to this fact, lyophilisation is suitable to use for an isolation of special types of natural substances.

Freeze-drying, also known as lyophilisation or cry desiccation, is a dehydration process typically used to preserve a perishable material or make the product, natural substances, with a minimize of the oxidation effects and other degradation processes and finally more convenient for transport. Freeze-drying works by freezing the material and then reducing the surrounding pressure to allow the frozen water in the material to sublimate directly from the solid phase to the gas phase [1, 4].

The aim of research studies were to use and optimisation the lyophilisation technology, as a fundamental procedure, for processing acetone extracts of Northern high bush blueberry (*Vaccinium corymbosum* L.) fruits and isolation of pure anthocyanins.

Anthocyanins are water-soluble vacuolar pigments that may appear red, purple, or blue depending on the pH medium. These natural components occur in all tissues of higher plants, including leaves, stems, roots, flowers, and fruits. Generally they have the considerable preventive and therapeutic effects in relation to different diseases: anti-

inflammation, antimicrobial, anti-tumor, anti-mutagenic and anti-oxidant pharmacological properties and a strong biological function.
In regard to the aim of our experimental work - the lyophilisation programs were tested for the anthocyanin extracts. These lyophilisation processes are gradually optimized so that the result of lyophilisation was a perfect dry lyophilized powder.

MATERIAL AND METHODS

The plant fruits of the bush blueberry (*Vaccinium corymbosum* L.) for the isolation of anthocyanins were collected from a large-scale cultivation of a special crop in the Krivá region. The locality is situated in North part of Slovakia, at altitude: 634 m above sea level, average temperature during the year is 6^{o} C and precipitation is 895 mm. The soil is very acidic with pH up to 4.2.
1000 g of fresh plant material was macerated in the excess of acetone volume from 3 to 5 times. The filtrate was separated by vacuum aspirator and transferred to a separator funnel and mixed with a double volume of chloroform and shaken several times. The solution was stored in a refrigerator overnight at 4° C. The aqueous phase was separated in the boiling flask. Acetone and chloroform additives were evaporated in a vacuum evaporator at 38° C. Extracts of fruits were supplied frozen in a content of about 400 ml.
Lyophilisation of anthocyanin extracts was carried out by the equipment GEA Lyophil SMART LYO SL2. This new equipment is localised at the Research and Development Department, Medicproduct, Co., Lipany, Slovakia. The liquid material (4 ml) was filled on an automatic filling line (Flexicom Watson Marlow FPC 50W, Denmark) into vials (size 10R, diameter 24 mm, height 45 mm). Vials were closed after filling, with rubber stoppers (type no. V9355) to the position for lyophilisation and were loaded into the lyophilisator. After lyophilisation the stoppers were closed and capped on the line (edging aluminium stopper type no. 25345). The prepared product was suitable for further processing and distribution to other workplaces for further analysis and research.
In general, the lyophilisation has several steps:
1. *Freezing.* On a larger scale, freezing is usually done using a freeze-drying machine. In this step, it is important to cool the material below its triple point, the lowest temperature at which the solid and liquid phases of the material can coexist. This ensures that sublimation rather than melting will occur in the following steps. Larger crystals are easier to freeze-dry. To produce larger crystals, the product should be frozen slowly or can be cycled up and down in temperature. This cycling process is called annealing. However, in the case of food, or objects with formerly-living cells, large ice crystals will break the cell walls, resulting in the destruction of more cells, which can result in increasingly poor texture and nutritive content. In this case, the freezing is done rapidly, in order to lower the material to below its eutectic point quickly, thus avoiding the formation of ice crystals. Usually, the freezing temperatures are between −50 °C and −80 °C [2]. The freezing phase is the most critical in the whole freeze-drying process, because the product can be spoiled if badly done. Amorphous materials do not have a eutectic point, but they do have a critical point, below which the product must be maintained to prevent melt-back or collapse during primary and secondary drying [2].
2. *Evacuation and primary drying.* During the primary drying phase, the pressure is lowered (to the range of a few millibars), and enough heat is supplied to the material for the water to sublime. The amount of heat necessary can be calculated using the sublimating molecules' latent heat of sublimation. In this initial drying phase, about 95% of the water in the material

is sublimated. This phase may be slow (can be several days in the industry), because, if too much heat is added, the material's structure could be altered.
In this phase, pressure is controlled through the application of partial vacuum. The vacuum speeds up the sublimation, making it useful as a deliberate drying process. Furthermore, a cold condenser chamber and/or condenser plates provide a surface(s) for the water vapor to re-solidify on. This condenser plays no role in keeping the material frozen; rather, it prevents water vapor from reaching the vacuum pump, which could degrade the pump's performance. Condenser temperatures are typically below −50 °C [1, 4]. It is important to note that, in this range of pressure, the heat is brought mainly by conduction or radiation; the convection effect is negligible, due to the low air density.
3. *Secondary drying.* The secondary drying phase aims to remove unfrozen water molecules, since the ice was removed in the primary drying phase. This part of the freeze-drying process is governed by the material's adsorption isotherms. In this phase, the temperature is raised higher than in the primary drying phase, and can even be above 0 °C, to break any physic-chemical interactions that have formed between the water molecules and the frozen material. Usually the pressure is also lowered in this stage to encourage desorption (typically in the range of microbars, or fractions of a Pascal). However, there are products that benefit from increased pressure as well. After the freeze-drying process is complete, the vacuum is usually broken with an inert gas, such as nitrogen, before the material is sealed. At the end of the operation, the final residual water content in the product is extremely low, around 1% to 4% [3].

RESULTS AND DISCUSSION

In regard to the organic solvent acetone, residues were determined after its evaporation from extracts by Hot space GC method (gas chromatography). The results of the determination of acetone residues are in interval from 0.06 to 0.13 % m/m. The extract does not contain any solvent residue.
The process of freeze-drying consists of the standard phases [1, 4]:
- Freezing - at atmospheric pressure,
- Evacuation - reducing pressure and primary drying - sublimation action - turning solid to gas and its dissipation from space of lyophilization,
- Secondary drying - removal of residual moisture at increased temperatures its dissipation from space of lyophilization.

The work on optimization of lyophilization consisted of two parts:
- Optimization of dilution of sample: because extracts from plant become after evaporation of solvents thick viscous liquids, for a successful lyophilization was necessary to dilute them with purified water in quality that declares the European Pharmacopoeia (*Aqua purificata* PhEur). The ration 1:1 is optimal for an extract from northern high bush blueberry.
- Optimization of lyophilization program: for each prepared extracts were tested and optimized various lyophilizating procedures with the most optimal process of lyophilization (Table 1 and Fig. 1) in order to finally achieve a dry lyophilized powder.

In regards to our experiences, the optimal extraction method and the process of freeze-drying for obtaining pure anthocyans from fruits of the bush blueberry (*Vaccinium corymbosum* L.) were developed. After lyophilization biological properties (antimicrobial and antioxidant properties) and the stability of anthocyanins were successfully tested.
Freeze-drying is a relatively expensive process. The equipment is about three times as expensive as the equipment used for other separation processes, and the high energy demands lead to high energy costs. Furthermore, freeze-drying also has a long process time,

because the addition of too much heat to the material can cause melting or structural deformations. Therefore, freeze-drying is often reserved for materials that are heat-sensitive, such as proteins, enzymes, microorganisms, and blood plasma [5, 7]. The low operating temperature of the process leads to minimal damage of these heat-sensitive products in our case the anthocyanins.

Table 1 Optimized lyophilisation programme for anthocyanin extract of Bush blueberry

Section	Temperature (°C)	Vacuum (μBar)	Time (min.)	Step
1	5	0	1	Loading
2	-30	0	60	Freezing
3	-30	0	120	Freezing
4	-30	200	30	Evacuation
5	-5	200	420	Drying
6	-5	200	240	Drying
7	5	200	330	Drying
8	5	200	210	Drying
9	35	200	240	Drying
10	35	100	240	Drying
11	35	50	270	Drying

NOTE: The parameter of vacuum: 0 is shown in lyophilization. This value indicates that in a chamber was atmospheric pressure. Pressures shown in μbars means reduction of pressure in regard to atmospheric pressure

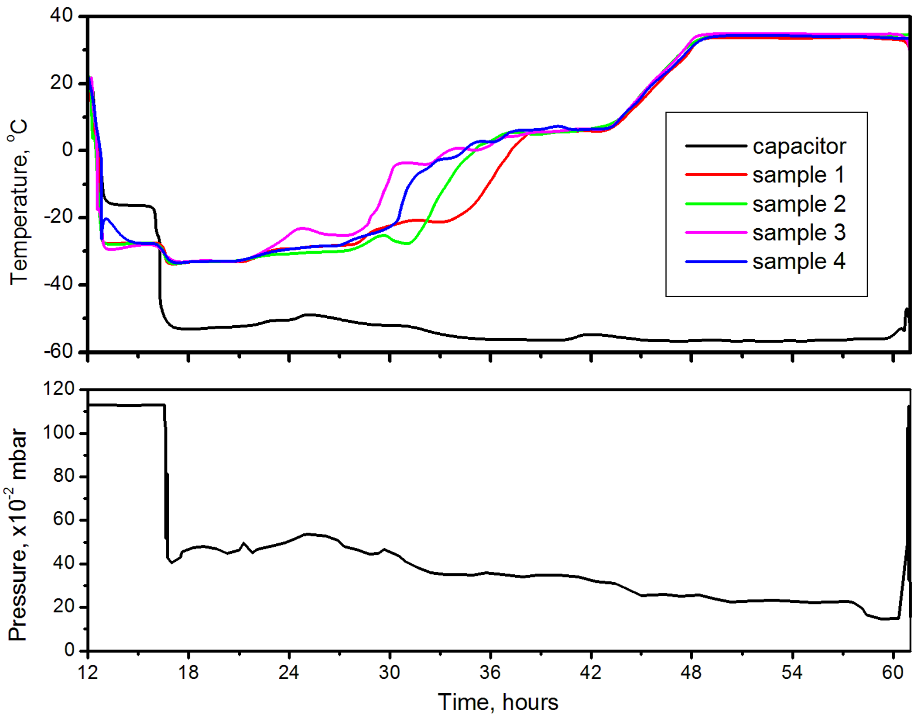

Figure. 1 The Courses of Temperature and Vacuum of Acetone Extract Vaccinium corymbosum L.

The freeze-drying is used to preserve food, the resulting product being very lightweight [5]. Another example from the pharmaceutical industry is the use of freeze drying to produce tablets or wafers, the advantage of which is less excipient as well as a rapidly absorbed and easily administered dosage form. In chemical synthesis, products are often freeze-dried to make them more stable, or easier to dissolve in water for subsequent use. In bio separations, freeze-drying can be used also as a late-stage purification procedure, because it can effectively remove solvents. Furthermore, it is capable of concentrating substances with low molecular weights that are too small to be removed by a filtration membrane [7].

CONCLUSIONS

In regard to our experimental results, freeze-drying for obtaining pure anthocyans from fruits of the bush blueberry (*Vaccinium corymbosum* L.) had these characteristics the drying temperatures: from +5° C (a primary drying temperature) through -31° C (sublimation point) to +35° C (a secondary drying temperature), the maximum drying pressure: 200 μBar and total time of lyophilization was about 36 hours.
Our research work was carried out in cooperation with the pharmaceutical company Medicproduct, Co. in Lipany (Slovakia), which uses freeze-drying to increase the shelf life of products, such as vaccines and other injectable. By removing the water from the material and sealing the material in a vial, the material can be easily stored, shipped, and later reconstituted to its original form for injection. Our new original research deals with an optimize extraction and freeze-drying procedures in order to the natural components. The purpose is carrying out a dry, quality lyophilized product, which is then submitted to further analytical and biological testing.

Acknowledgement

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ANALYSIS OF THE ELECTROMAGNETIC FIELD IN THE SURROUNDINGS OF SELECTED DEVICES

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Abstract: *The issue of electromagnetic fields emitted by different types of devices is currently a very hot topic. Extensive research is being carried on in this field mainly regarding the impact of these emissions on the human body. This article focuses on measuring and comparing the electromagnetic field of devices that are commonly used in our neighbourhood and residential environments.*

Keywords: *Electromagnetic field, device, electric field strength.*

INTRODUCTION

The most commonly used device in homes producing electromagnetic radiation is the Microwave Oven (MWO). The Microwave Oven is a commonly available appliance that does not transmit data but still radiates signals in the unlicensed 2.4 GHz Industrial, Scientific and Medical (ISM) band. The MWO thus acts as an unintentional interferer for IEEE 802.11 Wireless Fidelity (Wi-Fi) communication signals [2]. The residential MWO has one magnetron tuned to approximately 2.45 GHz (the commercial MWO uses two magnetrons), and typically radiates across the entire Wi-Fi spectrum. This device emits electromagnetic Radio Frequency (RF) power that, when operating simultaneously and in proximity to Wi-Fi devices, can cause data loss [1] and even connection termination. For this reason, the common residential MWO is the most critical application to investigate with the goal of interference mitigation through the use of cognitive radio [2].

CHARACTERISTICS AND PHYSICS OF MICROWAVE OVEN

Microwaves are electromagnetic waves. Their frequencies (wavelengths) are in the range from 300 MHz (λ = 1 m) up to 300 GHz (λ = 1 mm). Regarding wavelengths as typical spatial dimensions, one realizes that microwaves do not have dimensions of μm, as might be expected from the misleading 'micro' in their name. Following international conventions, microwave ovens at home or in restaurants operate at frequencies of about 2.45 GHz, i.e. λ = 12.23 cm. Microwaves are generated in a magnetron which feeds via a waveguide into the cooking chamber. This cuboid chamber has metallic walls and so acts as a Faraday cage. The front door, made of glass and the light bulb cavity are both covered by metal grids. The holes in the grids are small compared with the wavelength of the microwaves; hence the grids act just like metal plates [3]. Typical microwave oven is shown in Figure 1.
The residential MWO signal, in the ON mode, is similar to a Frequency Modulated (FM) signal with a frequency sweep, as is clearly seen in the spectrogram [4] in Figure 2. The frequency sweep in the MWO signal exists for less than half of the 60 Hz time period, typically 5-6 ms. During the frequency-sweeping part of the ON cycle, the radiated signal can

be characterized as an FM signal with varying power levels. The latter property lends itself to an Amplitude Modulated (AM) mode. Thus, a combined AM-FM waveform will serve as a basis for the frequency-sweeping part of the signal [5].

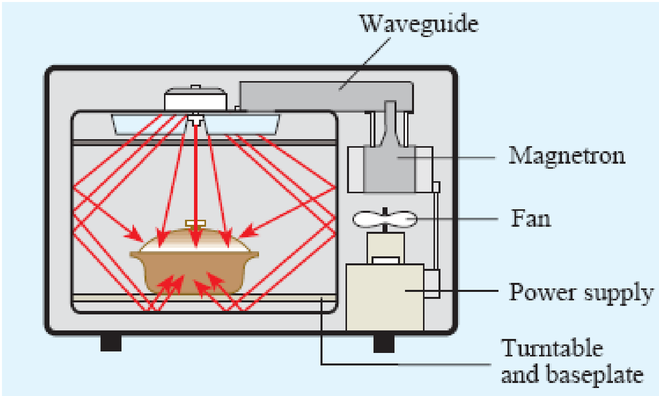

Figure 8: Schematic diagram of a typical microwave oven [3]

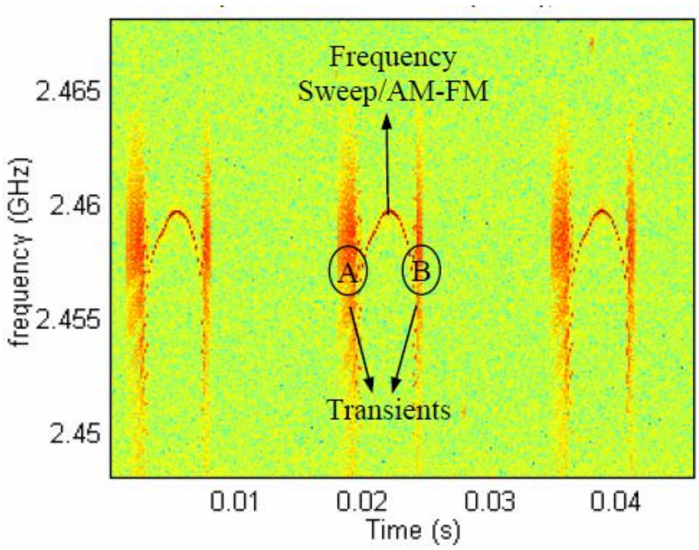

Figure 9: Spectrogram of typical MWO signal [2]

MEASUREMENT OF ELECTRIC FIELD STRENGTH OF MWO

Measurements of the electric field strength have been made in the area MWO. The parameters of the MWO are as follows: Input voltage 230 V, input frequency 50 Hz, input power 1200 W, output power 700 W and operating frequency 2,45 GHz. MWO worked in maximum mode (HIGH level). MWO was placed on the table and its center was located at a height of 1.0 m above the floor.

Description and measurement setup

Electric field strength measuring was made of five pages, in particular at a distance of 0.2 m, 0.5 m, 0.8 m and 1.0 m from the front door, rear wall and side walls as well as at a distance of 0.5 m and 1.0 m from the upper wall of MWO. Measuring probe for all measurements was placed at 1.1 m and 1.5 m above floor level. Measuring analyzer was set in the following parameters: resolution bandwidth (RBW) 3 MHz, video bandwidth (VBW) 300 kHz, measurement range 4 V/m and range of frequency bands from 2.3 to 2.6 GHz. Measured values were reading displayed on the analyzer at the Max Hold.

Measuring equipment

To measure was used the spectrum analyzer Narda SRM 3006 with isotropic probe 3502/01, whose measuring range is within $0{,}14.10^{-3}$ - 160 V/m. Frequency range of probe is from 420 MHz to 6 GHz.

Measurement results

Measurement results are shown in the following tables. Table 1 shows the results of electric field strength measurement from the side MWO (wall, where it is located magnetron). Table 2 shows the results of measurement from the front of the MWO (door). Table 3 shows the results of measurement from the back wall of the MWO. Table 4 shows the results of measurements from the side (opposite side of the magnetron). Table 5 shows the results of measurements from the top of the MWO.

Table 1: Results of electric field strength measurement from the magnetron side

Distance from the source (MWO) [m]	Electric field strength (V/m)	
	Height of the probe 1,1 m	Height of the probe 1,5 m
0,2	1,646	0,941
0,5	1,380	0,510
0,8	0,427	0,507
1,0	0,468	0,503

Table 2: Results of electric field strength measurement from the door side

Distance from the source (MWO) [m]	Electric field strength (V/m)	
	Height of the probe 1,1 m	Height of the probe 1,5 m
0,2	3,893	1,106
0,5	1,707	1,048
0,8	1,168	0,925
1,0	0,883	0,805

Table 3: Results of electric field strength measurement from the back wall

Distance from the source (MWO) [m]	Electric field strength (V/m)	
	Height of the probe 1,1 m	Height of the probe 1,5 m
0,2	1,201	0,910
0,5	0,785	0,621

0,8	0,608	0,673
1,0	0,595	0,491

Table 4: Results of electric field strength measurement from opposite side of the magnetron

Distance from the source (MWO) [m]	**Electric field strength (V/m)**	
	Height of the probe 1,1 m	**Height of the probe 1,5 m**
0,2	2,708	1,107
0,5	1,519	0,722
0,8	0,876	0,511
1,0	0,594	0,680

Table 5: Results of electric field strength measurement from the top of the MWO

Distance from the source (MWO) [m]	**Electric field strength (V/m)**
0,5	0,617
1,0	0,459

Identification of the source frequency in spectrum mode is shown in Figure 3. The highest values of the electric field strength were in the range of frequencies 2.454 to 2.464 GHz.

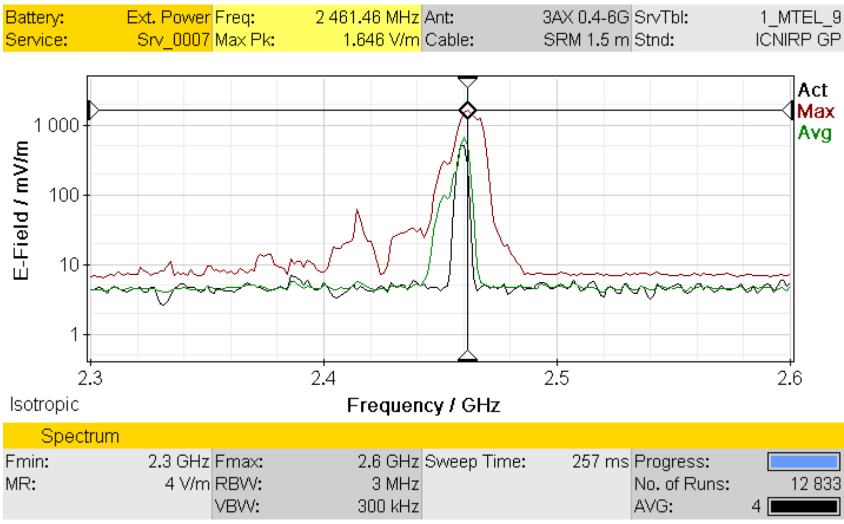

Figure 10: Spektrum analysis

CONCLUSIONS

Summarize of the reference levels for occupational exposure and exposure of the general public are illustrated in Figure 4. The reference levels are intended to be spatially averaged values over the entire body of the exposed individual, but with the important proviso that the basic restrictions on localized exposure are not exceeded [6]. Exposure action values set by

International commission on non-ionizing radiation protection (ICNIRP) were also included into the Slovak legislation. Action value is under ICNIRP and Slovak legislation provided for in this frequency range to 61 V/m.

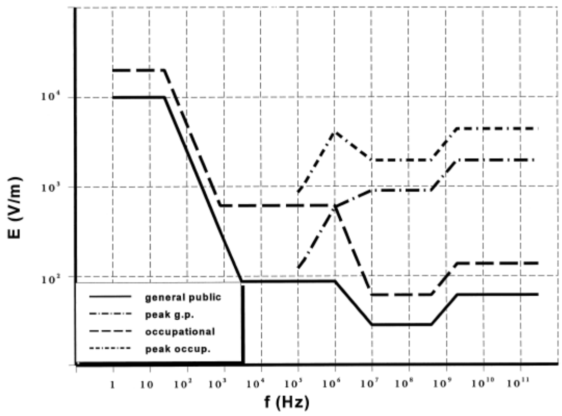

Figure 11: Reference levels for exposure to time varying electric fields [6]

The general public comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to electromagnetic field. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimize or avoid exposure. It is these considerations that underlie the adoption of more stringent exposure restrictions for the public than for the occupationally exposed population [6].

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THE BIOSYNTHESIS OF SILVER NANOPARTICLES WITH VARIOUS PLANTS EXTRACTS

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Abstract: *Metal nanoparticles have been of great interest due to their interesting properties such as electrical, optical, catalytic, and magnetic. The various methods were reported in literature for synthesis of metal nanoparticles but most interesting is so called "green chemistry" method because of use of different plants extract.*
We have studied the biosynthesis of Ag nanoparticles with ude of extracts of Melissa officialis L., Menta piperita and Calendula officialis L. as reducing agents. Effects of different plant materials on the process of Ag nanoparticles formation has been investigated by methods of UV-VIS- (Shimadsu UV1800), FTIR-spectroscopy (Shimadsu IRAffinity-1) and X-ray diffraction analysis. We have observed the polydisperse Ag nanoparticles were varied from 10 to 50 nm. Ag nanoparticles are mostly spherical in shape with few distorted and elongated due to agglomeration in some samples.
Surface charge and content of freshly prepared nanoparticles were found mainly responsible for change in the nanoparticles size. Plants extract functional groups and synthesis conditions played important roles in developing surface charge on metallic nanoparticles. This single-pot synthesis and rapid protocol may be applied for the preparation of a variety of plant extracts to explore their application in biosynthesis of novel metal nanoparticles.

Keywords: *biosynthesis, silver, nanoparticles, plants extracts*

INTRODUCTION

Research and development in the field of nanotechnology is growing rapidly around the world. A major output of this research is the synthesis of new materials in the nano-meter scale, including nanoparticles. Metal nanoparticles are displays unusual physicochemical properties and biological activities compared to the bulk parent materials. It is a reason why, a number of chemical, physical, and biological techniques are being used for the obtaining of metal nanoparticles. Development of metal nanoparticles integrated the reduction of metal cations and stabilizing them by chemical stabilizer. Metal nanoparticles have been of great interest due to their interesting properties such as electrical, optical, catalytic, and magnetic. A number of methods including such as electrochemical reduction, photochemical reduction, heat evaporation, physical and chemical methods were used for the synthesis of silver nanoparticles.
A naturally motivated investigation for the biosynthesis of nanoparticles is now established as an emerging area of nanoscience research and development. The nature is a rich source of extract proposed by variables of flora and fauna like plants, organism, microorganisms, etc. Over the past years plants, algae, fungi, and bacteria have been used for production of low-cost, energy-efficient, and nontoxic metallic nanoparticles. The various methods were reported in literature for synthesis of metal nanoparticles with use of different plants extract, but there is no report found in the literature which may offer a optimal protocol to prepare any plant leaves extract. The selection of three plants was based on their ease of availability and

wider occurrence in local areas. They were: *Melissa officialis* L., *Menta piperita* and *Calendula officialis* L. Herein, a single-pot synthesis protocol for rapid preparation of nanoparticles using three plants extract is discussed including their stability and characterization details. The Ag nanoparticles were synthesized efficiently without addition of capping or stabilizing agent and toxic solvents.

EXPERIMENTAL

$AgNO_3$ salt was used to prepare silver solutions and purchased from Sigma Aldrich. Glasswares were washed in dilute nitric acid, then distilled water and dried in hot air oven before use. Plants samples were collected locally from Presov, Slovakia. Plant leaves were separated from other plant parts and washed three times with distilled water to eliminate dust from surface of the leaves. The plant leaves were dried at room temperature for 48 h and 100 g of leaves were mixed to 500 mL distilled water in a 1000 mL Erlenmayer flask. The flask content was boiled for 20 min on a hotplate, thereafter the extracts were filtered in a storage bottle. The similar process was done for all three plant samples. Plants extracts were stored at room temperature for further use in biosynthesis of metallic nanoparticles.
Silver salt weighed accurately to prepare 100 mM aqueous solution and diluted to desired concentration for the synthesis of AgNPs and AuNPs. To investigate different PLE-derived AgNPs and AuNPs properties, 15 mL of PLE were added dropwise in 100 mL of 1 mM salt solution at room temperature with a constant stirring. The color of the silver salt solutions started changing from colorless to brownish in 10-12 min reaction time, indicating the development of silver nanoparticles. Further the brownish color of silver colloidal solutions changed to brownish-yellow solutions, confirming the presence of silver nanoparticles.
UV spectra of developed nanoparticles were obtained from UV–VIS spectrophotometer (Shimadsu 800). Synthesis of nanoparticles by various plant extracts was obtained to predict the effect of different reducing agent.
The aqueous solutions of synthesized silver and gold nanoparticles were dried in a porcelain dish at 90 ^{o}C. The dried materials were scratched with a glass rod to get the powder form for XRD analysis. The same samples have been used for FTIR (Shimadsu) analysis. Functional groups responsible for metal ion reduction to nanoparticles were analysed by IR analysis. Both the native plant extracts and resulting plant extracts after synthesis of metal nanoparticles were analyzed by IR in range of 4000–400 cm^{-1} with a resolution of 4 cm^{-1}.

RESULTS AND DISCUSSION

Effects of different plant materials on plant extracts developments were investigated. TRD observation revealed that the polydisperse Ag nanoparticles were varied from 10 to 50 nm.. Ag nanoparticles are mostly spherical in shape with few distorted and elongated due to agglomeration in some samples. Possible functional groups of plant extracts used for synthesis and stabilization of metal nanoparticles were studied by FTIR spectroscopy. The absorbance peaks of different plant extracts, Ag nanoparticles were presented in a series peaks in IR spectra. Results showed that water soluble organic compounds of different PLE are responsible for synthesis and stabilization of nanoparticles.

CONCLUSIONS

Plant leaves extract-mediated synthesis (plants including Melissa officialis L., Menta piperita and Calendula officialis L) showed well-characterized production of Ag nanoparticles at room

temperature. The average crystal size, content and stability varied in different plant leaves extract-derived Ag nanoparticles.
Surface charge and content of freshly prepared nanoparticles were found mainly responsible for change in the nanoparticles size. Plants extract functional groups and synthesis conditions played important roles in developing surface charge on metallic nanoparticles. This single-pot synthesis and rapid protocol may be applied for the preparation of a variety of plant extracts to explore their application in biosynthesis of novel metal nanoparticles.

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ULTRASOUND-ASSISTED EXTRACTION – RAPID METHOD OF AN ELEMENT FORM ISOLATION IN THE FRACTIONATION ANALYSIS OF SOILS

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Abstract: *This work represents results of optimization of ultrasound-assisted extraction of the soil sample (of two granularity fractions), collected in the vicinity of the metallurgical complex U. S. Steel, s.r.o. Košice, by the ethylenediamine tetraacetic acid (EDTA). For generation of the ultrasound was used a titanium probe and both the power generator and the extraction time were optimized. Results of the ultrasound-assisted extraction were compared with results of the conventional 1-hour extraction. Correctness of results of the optimized procedure of ultrasound-assisted extraction was validated by CRM BCR 700. Due to effect of ultrasound was the extraction time reduced to 4 minutes, at the generator output 450W. The results also pointed on the effect of size of particles on the behaviour of ultrasonic extraction. Experimentally was determined, that the extraction speed is significantly increased with reduced size.*

Keywords: *Soil, Fractionation analysis, Single-step extraction, Ultrasound-assisted extraction, EDTA*

INTRODUCTION

The issue of soil contamination by heavy metals is today extremely topical. The fractionation analysis is frequently used for assessment of ecotoxicity and bioavailability of various physical and chemical forms of elements. This method is defined as any isolating and separating method, or sequentially sorted procedures, leading to classification of analytes or groups of analytes into fractions, on a base of similar physical or chemical properties [1]. The fractionation analysis is therefore a suitable method for assessment of mobility of elements in environmental samples and between them, since it provides isolation of differently moving forms and subsequent quantification of elements in isolated forms.

In most cases, for determination of content of the element forms with different behaviour or mobility in the environment, are used methods that are based on extraction with a suitable extraction agent. These methods provide data which are used for assessment of mobility of element forms in the soil system. Conventional extraction of samples in the fractionation analysis according to standard procedures is performed by shaking of the sample and the extraction reagent in a polyethylene extraction pot on a mechanical shaker. The extraction time varies from 1 hour (e.g. 0.05 mol dm^{-3} EDTA) [2] up to 16 hours (0.43 mol dm^{-3} CH_3COOH) [3]. By the use of EDTA is content of the elements extracted in the so-called "*mobilizable*" forms (*water-soluble, ion-exchangeable, organic and carbonated forms*). The mobilizable form represents a content of the element, variable under changed soil conditions, dependent to current interventions of agrochemicals and agrotechnology, which are the most important from the aspect of acceptance of elements by the agricultural products. Complexing agents, like diethylenetriaminepentaacetate acid (DTPA) and EDTA release the fraction of elements, mobilised by complexing processes [4].

Utilization of the ultrasound for homogenisation of the sample has in recent years in the analytical chemistry an upward trend [5]. For this purpose is most often used an ultrasonic bath or the ultrasound probe. Probes have advantage over the ultrasound baths, as their energy impacts the local zones of the sample, what is more effective. The ultrasound-assisted extraction is currently seen as an alternative method to conventional extraction procedures - time consuming wet processes, during which the sample is quite often contaminated. By application of this procedure can be assumed, that the extraction will be accelerated, therefore the extraction time, which is in current procedures required for extracting of the element forms from a sample, will be shortened [6, 7, 8]. Applying of the ultrasound has similar effect like shaking; there is a partial or complete extraction of elements from the sample and at the same time is reduced the particle size, as well as the contact surface of the sample and extraction agent.
Utilization of the ultrasound in a fractionation analysis is aimed at reduction of required extraction time, needed for extraction of required element forms and it is especially preferred in sequential extraction procedures [6, 7, 8, 9, 10].

EXPERIMENTAL

Soil samples were collected in autumn 2007 on four different places near the metallurgical complex U. S. Steel s.r.o. Košice, which are marked on the map (Fig. 1). The collection was performed by a spade; by which was the soil profile revealed in a vertical direction up to depth of the topsoil. Excavated was a pit of a size approximately 30 x 30 cm and then was by a spade separated thick layer (5 cm) over the entire depth of exposed topsoil. The side walls were trimmed by a knife, thus a partial sample was acquired and stored into a carrying pouch with identification data. After transfer to the laboratory, the sample was freely dried in the air and then was subjected to suitable treatment. After quartation were removed and further processed 2 portions. Then, the soil was manually grinded in an agate bowl. Such grinded soil was sifted through sieves with mesh size 0.2 mm and 2 mm, transferred to a polyethylene pot and subsequently used for individual extraction procedures.

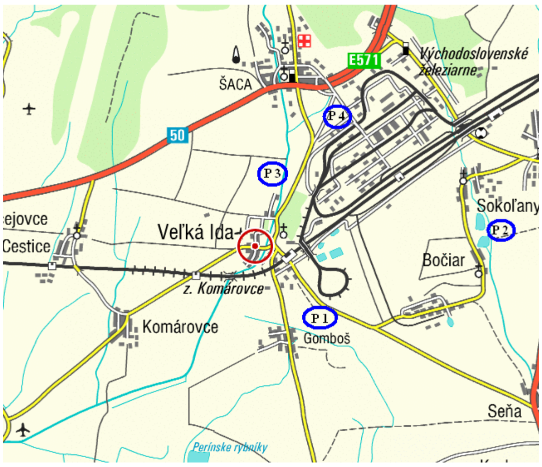

Fig. 1 Collection sites of soil samples

P1 *-in the vicinity of water-management objects of the slag-heap facility (U. S. Steel – Gomboš)*
P2 *-in the vicinity of the waste water treatment plant (U. S. Steel – Sokoľany / Bočiar)*

P3 -*in vicinity of Veľká Ida*
P4 -*in close vicinity of U. S. Steel*

For extraction of *"mobilizable"* forms of elements was used the extraction agent 0.05 mol dm^{-3} EDTA (pH=7, modified NH_4OH), or its disodium salt Na_2EDTA. Conventional single-step extraction procedure was performed via technique used for soil samples [2, 11]. To the sample, placed in a 100 cm^3 polyethylene extraction vessel, was added an extraction agent EDTA and immediately shaked in a mechanical shaker (MDGS TS - 400 D) at 240 revolutions per minute for 1 hour at room temperature. For the extraction of soil samples were used 5 grams of the sample and 50 cm^3 of the extraction agent, according to standard methodologies.
For the ultrasound-assisted extraction was used an ultrasound disintegrator (Person-Ultragen UZD 500, Slovakia), equipped by a titanium probe with a maximum power requirement of the ultrasonic generator 500 W. For extraction, were used polyethylene vessels and the extraction ratio was the same as for the conventional extraction. The extracts were after elapsing of the conventional and ultrasound-assisted extraction filtered through a filter paper with the smallest diameter of pore size 18.5 cm, into a polyethylene vessel. Content of selected elements in extracts acquired by this procedure was determined by the AAS method, with flame atomization on the instrument Perkin Elmer 3030.

RESULTS AND DISCUSSION

Results of the fractionation analysis of soil samples, performed by conventional extraction for both extraction reagents are listed in the Table 1. Presented educts represent the percentage of given element in the forms defined by used extraction reagent. On the basis of results in Table 1 can be stated, that relatively high content of elements in the mobilizable fraction was concentrated in the soil sample P3, i.e. in vicinity of Veľká Ida. Because this area was at the same time also a collection locality of the dust gravity fall, for next experiments we used the sample from soil P3.

Table 1: Extraction reagent (0.05 mol dm^{-3} EDTA)

Element	Content in the mobilizable fraction / %			
	P1	P2	P3	P4
Cu	34.4	25.4	**30.9**	19.7
Pb	23.5	24.9	**30.9**	19.7
Zn	5.5	3.7	**5.1**	3.4
Ni	26.2	30.8	**34.6**	29.3

Optimization of the ultrasound-assisted extraction was focused on monitoring of effect of the ultrasonic generator output and the extraction time upon relative recoveries of elements, which were calculated according to a formula:

$$R_R = \frac{R_U}{R_C} \times 100 \quad [\%] \qquad \mathbf{(1)}$$

where:
R_R - percentage of relative recoveries of the element, by the use of the ultrasound probe, with regards to its recoveries in extract of the conventional extraction,
R_U - percentage of the recoveries of the element by the use of the ultrasound probe, with regards to overall content in the sample,

R_C - percentage of the recoveries of the element in extracts of the conventional extraction, with regards to overall content in the sample.

The first step in optimization of the ultrasound-assisted extraction was monitoring of effect of the ultrasound generator (350, 400, 450, 500 W) with the soil size fraction from 0.2 - 2 mm, at the 4 minutes extraction time, on the relative recoveries of elements in the extract 0,05 mol dm^{-3} EDTA. For each output were performed two parallel extractions with 10 repeated measurements in each extract. From their average were calculated the relative recoveries (R_R) graphically recorded in Fig. 2.

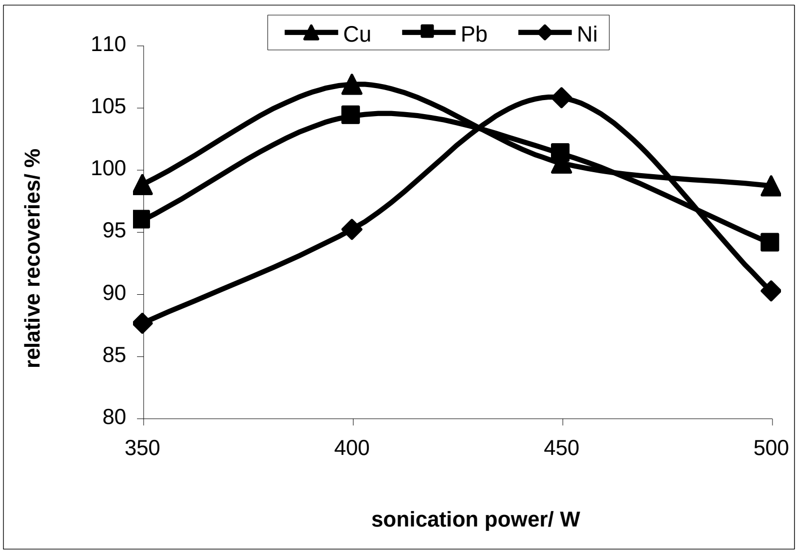

Fig. 2 Graphical dependence of the relative recoveries on the ultrasound generator output

The result from the presented graphical dependence is that the ultrasound generator output has slight effect on the relative educt of elements. Maximum content of Cu and Pb was achieved at the sonication power 400 W and of Ni at the sonication power 450 W. Based on the content, as an optimum output was determined an output 400 W, which had smaller effect on the sample suspension and the extraction agent.
Another series of experiments was focused on optimization of the extraction time. Here was monitored effect of the extraction time by the EDTA acid, at the sonication power 400 W, with the P3 soil sample size fraction from 0.2 - 2 mm. Identically like for output optimization, also in this case were at each time performed two parallel extractions with 10 repeated measurements in each extract and from their average were by calculation determined values of relative educts.
Based on graphical dependency presented in Fig. 3 we can state that about 100% relative content of element was achieved after 4 minutes of extraction for copper and plumbum and after 6 minutes for nickel.

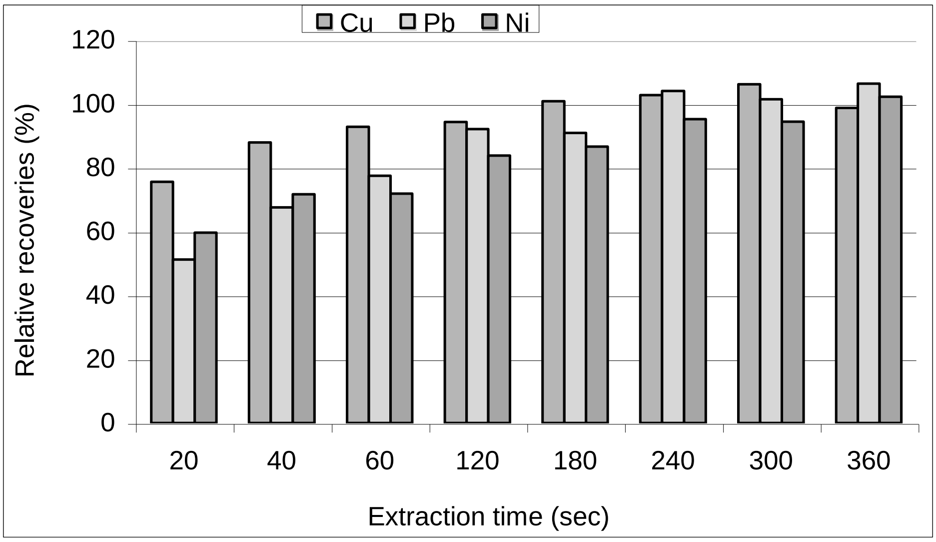

Fig. 3 Graphical dependency of the relative recoveries on the extraction time (fraction from 0.2 to 2 mm)

Extraction time 4 minutes of ultrasound-assisted extraction was selected as the optimum time. This time was verified by the CRM BCR 700 analysis, which is certified for purposes of the soil fractional extraction EDTA. Visible differences of uncertainties presented in Table 2 between our and certified values are caused by a fact, that our measurement was performed under ideal conditions, contrary to certified values, which were determined as reproducibility [11].

Table 2: Results of the ultrasound extraction CRM BCR 700 (Organic-rich soil)

	Measured value / mg kg^{-1}		Certified value / mg kg^{-1}	
Element	Content	Uncertainty	Content	Uncertainty
Cu	91.4	1.68	89.4	2.8
Pb	121.02	1.08	103	5
Ni	52.31	0.60	53.2	2.8
Zn	435.74	1.35	510	17
Cd	68.17	1.59	65.2	3.5

Besides to elements monitored by us, this time and output of the ultrasound generator were verified by CRM BCR 700 also for cadmium and zinc. Based on results we came to a conclusion, that both optimized output and time are probably suitable also for isolation of cadmium and zinc.

Due to fact that at 450W output of the generator was achieved about 100% content for nickel further experiments were focused on monitoring of effect of granularity upon speed of the ultrasonic extraction. For experiments was used a P3 soil sample, with particle size below 0.2 mm.

Based on graphically recorded results in Fig. 4 can be stated, that for all monitored elements was achieved the relative content of element 100% already after 20 seconds of ultrasound application. For the size fraction below 0.2 mm is required even shorter time for extracting element forms, than for fraction from 0.2-2 mm. From the graphical illustration can be assumed, that this time can be even shorter for zinc and copper, as the values of relative recoveries are fluctuating around 120% for copper and 130% for zinc. As can be seen later, portions of elements extracted above 100% R_R probably correspond to some other than mobilizable forms.

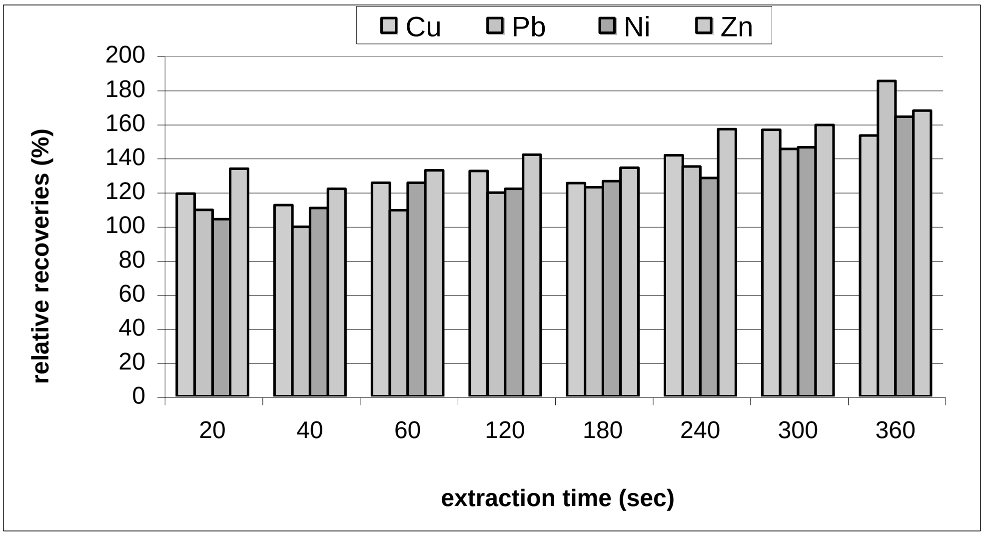

Fig. 4 Graphical dependency of the relative recoveries on the extraction time (fraction below 0.2 mm)

Significant increase of the speed of the ultrasound-assisted extraction when the softer soil fraction is used is caused by effect of the ultrasound upon reduction of particle sizes and by increase of the contact surface between the sample and the agent, while this effect upon larger particles is less significant. Because for purposes of the fractionation analysis is commonly used a soil fraction below 2 mm, utilization of the ultrasound for acceleration of extraction is well founded.

CONCLUSION

Based on results of this study can be stated that:

- the ultrasound accelerates an EDTA extraction process in the fractionation analysis,
- an optimal procedure of the ultrasound-assisted extraction was determined at 400W output of the generator and at extraction time 4 minutes,
- the speed of ultrasound-assisted extraction is significantly increased with reduced size of particles,

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THE SOLVING OF WASTE IN WATERJET TECHNOLOGY

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Abstract: *The clean production technologies are very popular in the present days, because they can save the cost soft producers and also can protect the environment. The cutting of materials by using of abrasive water jet belongs to one of clean technologies, which utilize the possibility to divide or cutting the materials that are sensitive to pressure in material processing. At the same time there is also a need to process the waste (water, abrasives, processing materials) after processing. The contribution deals with the technology of waterjet cutting, where the water quality is very important, aspect of using the water as a tool, its consumption, cleaning, recycling describing the requirements on the quality water from the point of production technology.*

Keywords: *waterjet cutting, clean technologies, water properties*

INTRODUCTION

Power of water in a form of erosion of materials has acted in nature for millions of years. High pressured water jet cutting, known also as jet-cutting, has been developed continually for several decades in research and industry. An important motion for water jet use in manufacturing technology as a tool has come from aircrafts and space industry.

Over the past five years, the number of waterjet cutting machines sold worldwide, both abrasive and pure water, has increased by an average of 18 percent annually. Fabricators are showing more interest in the technology as they realize it can cut metals of various thicknesses and different materials, but the question with the waste is still important. The best advantage of this technology in comparison to other cutting methods is a cold cutting process.

The question with the waste is still important. Economical production also must focus on cost reduction. One of the factors contributing to the production cost in AWJM is the cost of abrasives.

CLASSIFICATION FOR WATER JET TECHNOLOGY

The given classification for water jet technology in Fig. 1 can be characterized also as jet technological water methods or as water jet technology, as normally used by internationally reputable research and technical community as well as by development and technology experts. [1]

Nowadays, a perpendicular cutting area of very high quality, dimensional accuracy of a cutting shape and relatively high cutting speed can be obtained by waterjet technology using values of pressure 350 MPa – 620 MPa for stationary high pressure pumps and 0,5 MPa – 320 MPa for mobile pumps. [1, 2, 3]

Other technological methods, cutting abrasives and technological modifications, which definitely substantially extend application potentiality of this technology, are being developed.

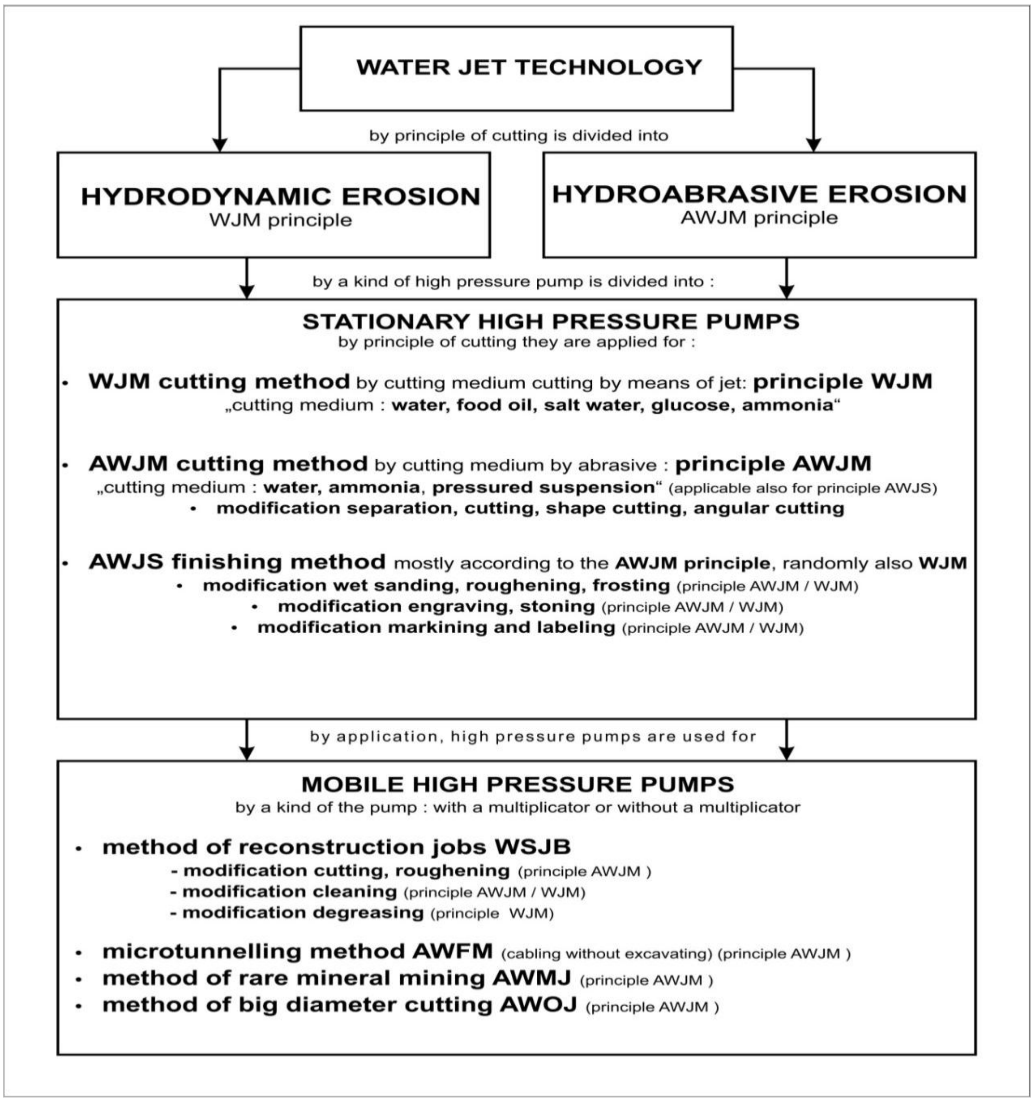

Fig. 1 Water Jet Technology Classification [1]

WATER PROPERTIES

The water properties depend on the chemical and physical properties. Also it depends on the utilization of water source and cleanness.
Due to less maintenance and protection of the nozzle components, rotating elements, valves and high pressure seals must be fed with treated water.
The water supplied to the intensifier is critical to waterjet cutting as part of the installation planning, a water quality analysis should be performed by a commercial company that specializes in water conditioning equipment. [7]
The minimum information that should be supplied by this analysis is Total Dissolved Solids (TDS), silica content and pH value. Inlet water should be treated for either the removal of hardness of the reduction of TDS. Water softening is an ion exchange process that removes scale forming minerals such as calcium. TDS reduction can be accomplished with either

deionization (DI) or reverse osmosis (RO) equipment. Generally, DI or RO provides better component life than water softening.
A high concentration of Total Dissolved Solids (TDS) causes accelerated wear of any components that come in contact with the high pressure water because of the increased abrasiveness of the water from the TDS. In the Tab. 1 is shown the water treatment guidelines. [7]

Tab.1 The water treatment guidelines [8]

Criteria	Values	Recommended Treatment
Total Dissolved Solids (TDS)	Low TDS (<100 ppm) Moderate TDS (100 - 200 ppm) High TDS (>200 ppm)	Good water, requires only softening Can be treated by softening, DI or RO Poor water, should be treated with RO or DI
Silica Content	High content (>15 ppm)	Dual Bed Strong Base DI
H Value	Treated water must have a value of 6 - 8	---

Detailed water quality is shown in the Tab. 2

Tab.2 Water quality

Water quality	Acceptable values	Good values	Very good values
Parts life subject to wear	Minimum	average	maximum
Alkalinity (mg/l)	50	25	10
Calcium (mg/l)	25	5	0,5
Carbon dioxide (mg/l)	0	0	0
Chloride as Cl (mg/l)	100	15	1
Free chloride (mg/l)	1	1	0,05
Iron as Fe (mg/l)	0,2	0,1	0,01
Manganese as Mn (mg/l)	0,1	0,1	0,1
Magnesium as Mn (mg/l)	0,5	0,1	0,1
Nitrates(mg/l)	25	25	10
Oxygen (mg/l)	2	1	0,1
pH (1)	6,5 - 8,5	6,5 - 8,5	6,5 - 8,5
Silicon (silicate) (mg/l)	15	10	1
Sodium (mg/l)	50	10	1
Sulphates (mg/l)	25	25	1
The total amount of dissolved solids (mg/l)	200	100	5*
Total hardness as $CaCO_3$ (mg/l)	15	10	1
Turbidity (NTU)	5	5	1

*This value may in no case be lower than this value, because otherwise the water was too aggressive.

The components of systems for water jet cutting are subjected to such a level of stress, in which are sensitive to the impact of the constituents in water and may result in local damage, for example corrosion. This can result in cracks and finally fully damaged metal pressure components. In the Tab. 3 are mentioned properties and following reasons of water quality.

When we want to characterize the water quality, we must also remind the other points as: [9]

- **Suspended solid** – the water must be filtered for the removal of suspended.
- **Solid.**
- **Water supply.**
- **Water circuit options.**

Tab. 3 Chemical composition of water

Component	**Chemical formula**	**Note**
Alkalinity	Bicarbonate (HCO_3) Carbonate (CO_3) Hydrate (OH) expressed as $CaCO_3$	A foaming and carry solid causes embrittlement of steels. Sodium hydrogen carbonate can generate CO2, is a source of corrosion.
Calcium	Ca	When dissolved, causing water hardness. Contributes to the boiler room stone.
Carbon dioxide	CO_2	Causes corrosion.
Chloride	Cl^-	Contributes to the solids content and increases the corrosive nature of the water in the presence of oxygen. Indicates corrosive cracking under stress.
Free chloride	Cl_2	Oxidizer. Negative effect on elastomer-sealed. It damages the membranes. Activated carbon filter removes chlorine.
Iron	Fe^{++} (ferrous) Fe^{+++} (ferric)	Discolored water at percipilation. Source boiler room stone and erosion.
Manganese	Mn^{++}	Like iron
Magnesium	Mg^{++}	When dissolved, causing water hardness. Contributes to the boiler room stone.
Nitrate	NO_3^-	Contributes to solids, but from an industrial point of view of its effect is not significant.
Oxygen	O_2	Causes corrosion.
pH		Depends on the acid or alkaline solids in water.
Sillica	SiO_2	Causes the formation of boiler room stone.
Sodium	Na	Commonly occurs and the water gets in the ion exchange process in water softening.
Sulphate	SO_4^-	Contributes to the solid content in water, is

		associated with calcium and creates stone boiler based on calcium sulphate.
Total dissolved solids TDS		The amount of dissolved solids in water.
Total hardness		The sum of all components of hard water, usually expressed as the equivalent concentration of calcium carbonate $CaCO_3$. First, because of the calcium and magnesium in solution, but can also contain small amounts of metals.

ABRASIVE WATER JET PROCESS

An abrasive water jet (AWJ) system typically consists of a high pressure pump, abrasive cutting head, abrasive delivery system, nozzle, motion system, control unit, spent abrasive catcher unit and settling tank. High pressure water flows through a sapphire or diamond orifice into the mixing chamber of the cutting head and creates a partial vacuum that draws in a metered flow of abrasive. [4,5]
The abrasive combines with the water jet to create the AWJ cutting stream that exits through the nozzle. Typical operating conditions are 200-350 MPa water pressure, mesh #50 - #120 abrasive, 0.24-0.40 mm orifice diameter, 0.76 - 1.70 mm nozzle diameter and 3.8 – 15.0 g/s abrasive flow rate. [6]

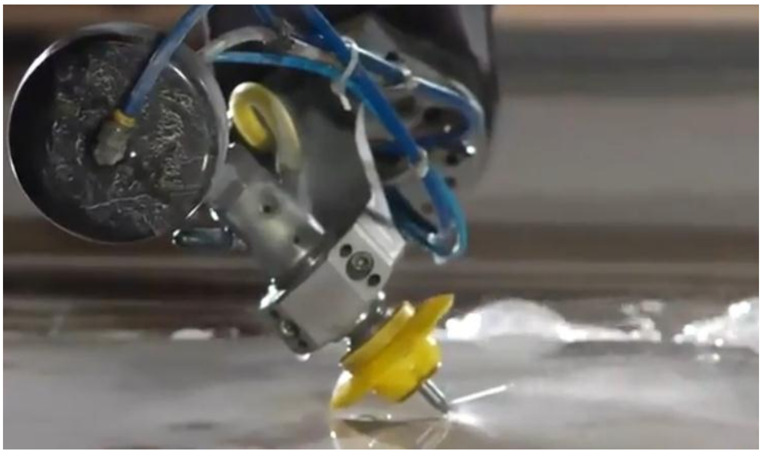

Fig.7 Nozzle of water jet cutting [18]

The nozzle (Fig.7) is the shortest lived component in the entire system. Until recently, nozzles were made from conventional tungsten carbide, which gave an effective life of about 4 hours when used with garnet abrasive. Nevertheless, material of nozzle exhibits a relatively short life with hard abrasives such as Al_2O_3 and SiC (Ness et al., 1994), thereby limiting the cost effectiveness of AWJ machining with such abrasives. [6]
Nozzle wear is a complex phenomenon influenced by the AWJ system parameters, and nozzle geometric and material parameters. In the Fig.4 is shown the wear of nozzle after 3 hours of work. [6]

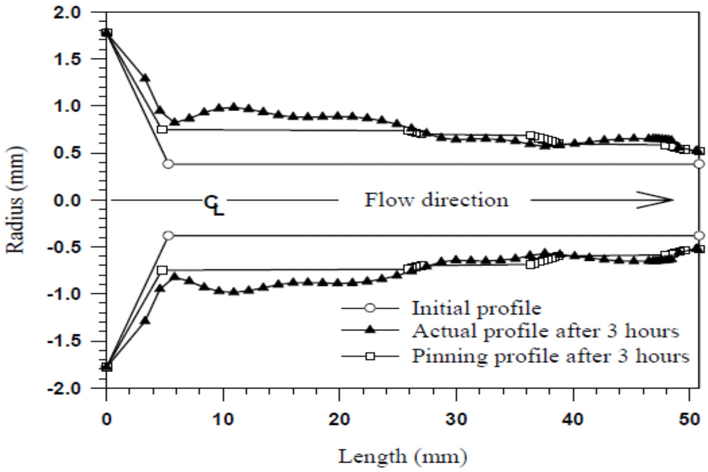

Fig.4 Comparison of pinned and actual profiles of WC/Co nozzle after 3 hours testing [6]

WATER TREATMENT SYSTEMS

Recommendation for water treatment has also the world famous firm WARDJet, that has found that the use of a good quality water softener in conjunction with a 0.2 absolute final filter to be successful for treatment of water for the intensifier. This setup can be used as long as the water from the cutting tank is not being recycled for use through the intensifier. In the worst case, if seal life does not seem to be living up to expectations, then a DI or RO system can be installed. In the Fig.2 is shown water treatment apparatus WRS 3000.

The Closed Loop Filtration System, Fig.3 is designed to close the drain by filtering the overflow water from the Waterjet table down through a bagfilter polishing off the water with a Hurricane Filter Cartridge and removing the dissolved solids with a DI Resin Vessel. The clean, treated water is returned to the intensifier pump at the pump manufacturer's proper specification. The mentioned system has advantages:

- Eliminate the drain completely. No dissolved solids go to drain. Allover flow water is filtered and reused.
- Protect your high pressure pump. The closed loop system always supplies the specified water conditioning water quality to the high pressure pump. The results are reduced pump maintenance and machine downtime.
- Maximize orifice life, reducing maintenance, maximizing performance
- Reduce High water/sewage costs
- Incoming water supply not sufficient
- Drastically reduce the requirement for make up water treatment such as softeners, reverse osmosis (RO), or deionizing (DI) water systems. The small amount of makeup water needed is treated before it goes to the high pressure pump.
- Well and septic water system
- Potential water rationing geographic area
- No drain in facility or drain not accessible
- Reduce water consumption -usually 2% to 10% of normal usage
- ISO 14000 requirement

Fig. 2 WARD water treatment apparatus WRS 3000 [8]

Fig. 3 The Closed Loop Filtration System Model #CLS-161

Fig.5: Mini hopper[17]

A recent advance in technology is remote CNC-control of the amount of abrasive released from the mini-hopper. Having this capability allows for optimum feeding of abrasive to the cutting head in relation to the water pressure at the pump for the following desirable capabilities:

- Piercing of fragile materials like glass or stone. Typically a lower water pressure will be used with a smaller amount of abrasive.
- Changing abrasive amount for different abrasive nozzle sizes to optimize part cost. This can be done automatically if the mini hopper is set up to do this (fig. 5) [17].

ABRASIVE RECYCLING SYSTEMS

In the world exist more types of separating and recycling methods of abrasives depends on technology: [10]

- magnetic separation,
- floating,
- sedimentation,
- filtration,
- setting of used abrasive material,
- recycling under water flow. [16]

The most famous abrasive recycling system are realized by the firms WARD - Waterjet Abrasive Removal Only System (AROS), Flow- WaterVeyor™ Abrasive Removal System, TECHNI-waterjet, KTM and others [12,13,14,15].
In the Slovakia is used mechanical system WATING - the entire development system is based on the patented technology, which during the first separation phases the effluent, is discharging (launched) from the table battle. In the next phase the abrasive material is picked out on the metal palettes and can pass to following washing process. In sedimentation process in the first part the maximum of 94 % of used abrasive grains are separated and only 4 % can be caught. Of course in the second sedimentation part about 2 % and in the third part it is not important for optimal performance because there is only water with slime.
In the Fig. 6 is shown the cost changing in dependence of feed rate and abrasive amount.

Smaller orifice/nozzle combinations are more efficient though in their use of water and abrasive. The available power of the waterjet is concentrated into a smaller area, so more power is directed to the cut. [11]

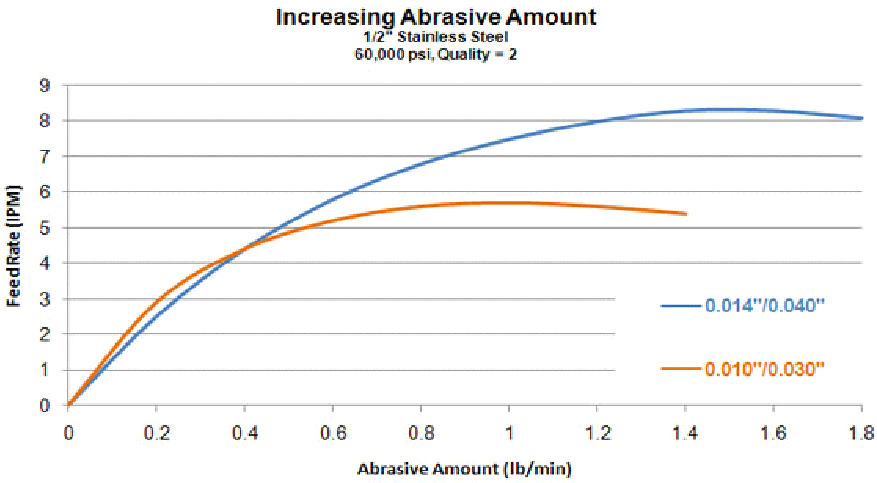

Fig. 6 The cost changing in dependence of feed rate and abrasive amount[11]

The final result consists in two products:

- **Recycled abrasive** – This is washed and dried, ready to resue. Similarly, new abrasive is used by water jet cutting and thus the recycled abrasive can be stored in the container for reusing.
- **Waste** – mud is stored in a 200 l barrel, which is ready for emptying on a waste dump. Mud is well compressible and does not contain much water, since water comes back to the tank. One of the advantages of this process is absence of soakage of redundant water. [1]

WASTE MANAGEMENT

Waste management and disposal have become increasingly more complex and expensive. Environmental liability is also a major concern with waste disposal. Many companies are now paying for environmental cleanups or have been fined by regulatory agencies as the result of poor waste disposal practices. Overall, fluid management provides a means to: [7]

- Operate in a more environmentally sound manner;
- Improve productivity and reduce costs;
- Increase competitiveness;
- Maintain environmental compliance and reduce environmental liability;
- Consistently manufacture quality products; and
- Provide a healthier and safer work environment for employees.

With increasing environmental regulation, a reduction in cutting fluid waste is an economical, practical and achievable goal.

CONCLUSION

The components in high-pressure water pumps and nozzles will wear out much faster if you have poor water quality, especially if there are a lot of minerals in it. If you suddenly find that you are wearing out nozzles faster than normal, suspect water quality to be the culprit.Through use, all nozzle materials wear and result in deteriorating jet quality and decreasing production rates.
Reducing abrasive consumption decreases direct part of cost. It also decreases the amount of work required to empty the abrasive out of the machine's tank and the cost of disposal. We can make some basic conclusion about consumption, recycling of abrasives [4, 7, 12, 14]:

- **Smaller Nozzles**. Using a smaller water/abrasive nozzle combination can reduce abrasive consumption dramatically.
- **Water Recycling Systems**. Closed-loop water recycling systems can help save on water costs. Recycling systems separate abrasives from the water, leaving cleaner water for disposal and also improving the quality of the water going into the pump, which helps increase the life of the pump and cutting components.
- **Abrasive Removal Systems.** Abrasive removal systems can reduce part cost by eliminating the downtime that is required to remove abrasive from the machine's catcher tank; the abrasive is removed automatically throughout the cutting process. Anyone who has had to do the back-breaking work of shoveling out the sludge from a waterjet will appreciate an abrasive removal system.

Acknowledgement

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ECOLOGICALLY ACTIVE SURFACES, THE BASIS FOR THE STUDY AND EVALUATION OF ECOLOGICAL FUNCTIONS

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***Abstract**: In studies of individual organization levels of organisms, the requirement of hollistic expression of structure and function is traditional despite the fact that structural direction prevails in studies. Less attention is paid to place where function activity appears in relation to structure. This place is surface – medium where physical, chemical, biological and synergic or affecting interactively processes which are called „Ecological Active Surfaces - EAS“. From this standpoint the surface is a e place for energy exchange appears like as mean studies of function and structural landscape elemens. Quantification of the surphace and their function (developed surface . activity – information values, function characteristics) is method-logical startpoint on landscape evaluation and its part regarding energy potencial of geografical environment. This evaluation shall be performed in various hierarchical levels and it result from relation of variabiles. We have achieved parcial results related to EAS during solution of tasks conected with the environmental evaluation of biotic components of a landscape, mainly during the investigation of aquatic biotopes, which are demonstrated on some examples.*

Keywords: *ecologically active surfaces, aquatic biotopes, Eastern Slovak Lowland*

INTRODUCTION

Application of ecological features and characteristics and their use in aquatic water facilities either breeding or hydraulic infrastructures ones is rather long-term process and not fully exploited yet. During the last two decades, we have gained amount of data supporting the relationship between morphological and biological characteristics that can be effectively used in a numerous sections of the water management. These opportunities arise from the existence of eco-active surfaces - EAS reflecting increased activity in different directions.

In the study of basic ecological problem "structure and function" there was given considerable attention to phenomenon and processes of water anthropogenic landscape elements, especially hydromelioration channels, flooded mining pits and dams. In terms of the agricultural landscape of Eastern Slovakia Lowland, they form a significant landscape element with its rather unknown and not very much used biotic functions. The primary objective of the study was to develop proposals that would increase biotic functions and their evaluation for landscape-ecological plan[9].

When studying different levels of the organization of a biological system, the requirement for a holistic expression of the structure and function is traditionally claimed. The reality is that the structural focus of the research at various hierarchical levels still prevails and almost no attention is paid to the place where the functional activity occurs in relation with the structure.

The place where the functional activity is demonstrated in connection with the structure is the surface is a medium where the physical, chemical, biological, and synergic processes take place which we call “ecologically active surfaces” - EAS. From this perspective, the surface is a place of energy exchange – is a means in the study of functional and structural properties of a biological object. The quantification of such surfaces, taking into account the functional activity per area or volume, is the methodological basis in the evaluation of the landscape or of its components after the assessment of the energy potential of the environment. This ratio may be regarded as the degree of the heterogeneity of conditions after taking into account the environmental gradient[15].

In the scietific literature can be find works studying phenomenon called an offshore, marginal, boundary, edge, outline, or contour effect [3], as well as biofilms, biological membranes, marginal layers and also active areas of biological surfaces, ecotones, wetted perimeter, impact zone etc. [15]. We worked on the problem of absolute isolation. The numerous authors claim that this layer is manifested by enlarged biological activity, respectively abundance, biomass and species abundance.

Nowadays there are many direct and indirect proofs and evidences, from the fields of physics, chemistry and biology in particular, about the existence of this layer. Results are showing that increased activity is a result of complexed photo-chemo-hydrodynamic interactions and other factors. Recently we can find amount of works stuying "boundary zones" from the elementary particles to the macro space.

When solving tasks related with the ecological evaluation in particular of aquatic ecosystems, we have achieved partial results with the presence of EAS and their use, which we will demonstrate. The results concern long-term monitoring of hydro melioration channels and studies of zooplankton of the river Latorica, a tributary of the river Tisza in Eastern Slovakia [17]. Results in the study of zooplankton in the river Rhine were evaluated in a similar way [16].

Similarly, the knowledge of EAS was used in the monitoring of the process of biodegradation of petroleum substances in the rivers of Latorica and Uh [20, 5].

The EAS theory has been used in the development of the categorization and optimization of channels of the Eastern Slovak Plain [23] and in the evaluation of the improvement of water quality in the upper part of the Domaša water reservoir in Slovakia [24]

The aim of this paper is provide information about the basic principles of a comprehensive study and evaluation of ecological functions. On the basis of the principles of the existence of EAS, the modelling of the relations between morphometric and fine structural characteristics of the biota, or between variables for the modelling of functional relationships in a holistic understanding of the structure and function, should follow.

The article was based on the results of laboratory and field monitoring, which was occasionally done for the last 25 years.

METHODS

In order to conduct the study, physical and chemical experiments were carried out, in particular the transfer of energy through a surface. solid substance - solid substance; solid substance - liquid; liquid - air (gas), etc. But such studies were carried out in order to study selected parameters.

We carried out a series of experiments to study integrating parameters, which merged the transfer of energy for inorganic and organic substances with the biological matter.

From among number results, I will demonstrate a simple experiment with natural algae cultures in containers in which the sizes of surfaces, as well as the trophy and cyanobacterial culture, change. Monitoring in semi-laboratory conditions was conducted in order to measure the values that would express the dependence of the production cyanobacteria and algae on the size of the contact surfaces, i.e. EAS - ecologically active surfaces – at various trophic potentials. Four series were in three repetitions with multiplying EAP sizes were prepared. In total 36 glass bottles were exposed for 14 days.

Upon the end of the exposure, biomass was determined in individual bottles with chlorophyll *a*. The extraction was done with acetone and it was measured by a spectrophotometric method (by STN 757715). The obtained values were re-calculated to 1 litre due to the fact that the installed surfaces (thin-walled glass tubes) displaced a certain volume of liquid when the surface area was multiplied.
N-0., F-0: The surface of the inside of bottles (volume 2 liters)
N-1., F-1: Surface inside bottles increased by 50 percent
N-2., F-2: Surface inner part increased by 100 percent
N-0, 1, 2, F-0, 1, 2, 1, 2, 3 (x) repeats

The cyanobacteria and algae culture was composed of the following species. *Raphidocelis subcapitata* Skulberg, *Monoraphidium cf.contortum* Reháková, *Chlorella kessleri* Long, O. Lhocky *Scenedesmus obliquus* O. Lhocky, *Scenedesmus quadricauda* Greifswald, and *Scenedesmus subspicatus* Brinckman.
In the intra-ambankment area of Latorica River (Eastern Slovakia lowland) we have analyzed relationship between changes in water level regime and qualitative-quantitative changes in zooplankton network in flooded reservoirs.
Similarly we are documenting water quality in multifunctional water reservoir Domaša, where due to the contact of relatively big surface of woody vegetation and flora in general, it leads to the elimination of nutrients and improve of water quality [24].
A fairly effective biodegradation of petroleum substances occurred in rivers Latorica and Uh [5,20].

RESULTS

The laboratory experiments clearly demonstrated the relation between the EAS and the periphyton (biomass of the natural culture of cyanobacteria, algae and cyanobacterial culture) biomass at different levels trophic potential (Table 1).
The production increases with the surface area at low trophic potentials and large surface areas (N-0, N-1, N-2).
The production is reduced after the nutrients are depleted in the artificial cyanobacteria culture with large areas (N-2).
The biomass of the natural culture of cyanobacteria and algae in pond water enriched with nutrients is more than 3 times higher than in the water in a natural environment (F-0, F-1, F-2).
The Cyanobacteria culture in nutrient-enriched water with does not show a significant increase in the biomass with a larger surface area (F-0, F-1, F-2).
The optimization process includes the determination of optimal parameters, such as the surface area, trophic level, exposure time, and temperature. The regression curves suggest that the increase in the production differs, expressed by an angle of 42 - 83° [18].

Tab.1 Cyanobacteria biomass production expressed in chlorophyll "*a*" *(μg·l⁻¹)*

Natural water pond (mg·l^{-1}). NH_4^+- 0.6, NO_2^- -0.04, NO_3^- -0.7, PO_4^{3-} - 0.3			Natural water pond with fertilizer (mg·l^{-1}). NH_4^+ - 10.2, NO_2^- -0.06, NO_3^- - 7.2, PO_4^{3-} - 0.7		
N-0-1	7.72	8.23	F-0-1	25.12	20.30
N-0-2	8.65		F-0-2	19.61	
N-0-3	8.31		F-0-3	16.18	
N-1-1	9.21	9.05	F-1-1	33.21	32.86

N-1-2	9.19		F-1-2	31.09	
N-1-3	8.75		F-1-3	34.27	
N-2-1	9.65	9.70	F-2-1	36.65	36.82
N-2-2	10.59		F-2-2	37.21	
N-2-3	9.88		F-2-3	36.60	
Cvanophytes culture			Cvanophytes culture		
N-0-1	12.61	12.97	F-0-1	17.70	17.58
N-0-2	13.74		F-0-2	17.36	
N-0-3	12.56		F-0-3	17.69	
N-1-1	16.88	19,29	F-1-1	19.89	19.88
N-1-2	19.43		F-1-2	18.65	
N-1-3	21.56		F-1-3	21.10	
N-2-1	6.28	5.81	F-2-1	21.99	21.61
N-2-2	5.88		F-2-2	21.10	
N-2-3	5.26		F-2-3	21.85	

When solving problems related to the environmental assessment of landscape elemens, particularly in the study of aquatic ecosystems we have achieved partial results with EAS, which we present (Fig.1, 2).

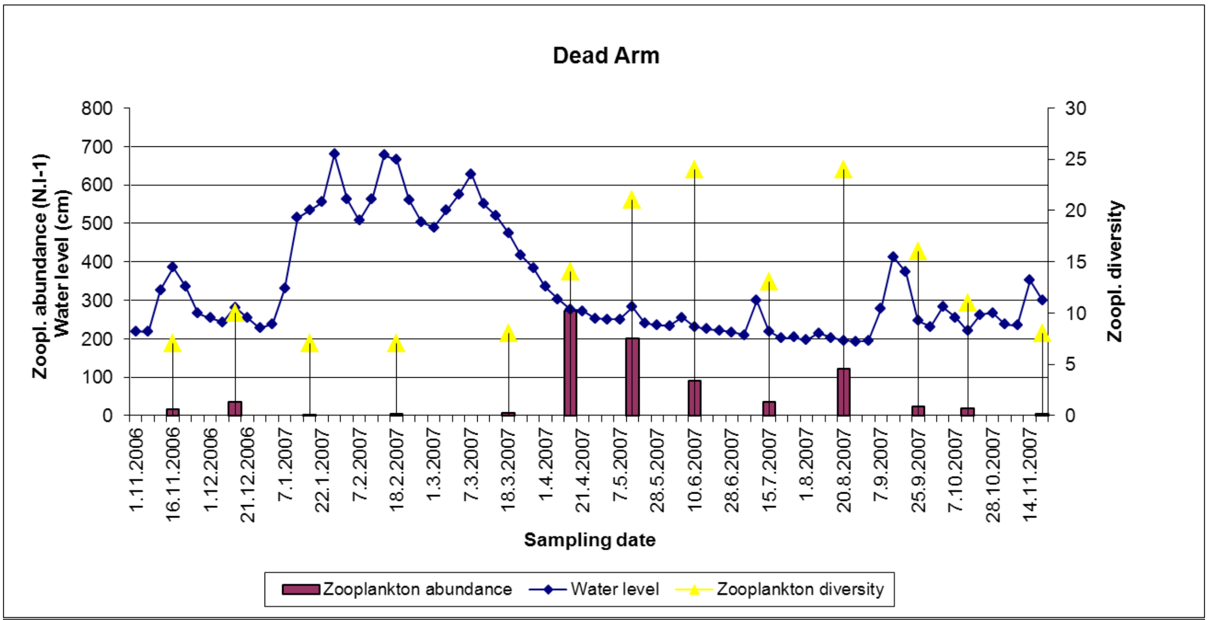
Latorica River, easpecially in dead branches and clay pits there is abundant species diverzity of zooplankton (Rotatoria, Copepoda, and Cladocera). This condition is related to the great variability of environmental conditions manifested in time and space, as well as the possibility of supplying species of r2afting and transport by birds. Ecologically diversed conditions in a small area are subject of constant water column changes, that is changes in contact zones meaning EAS where border effect is manifested by increased species diversity and its production [14,15,17], 64 taxa Rotatoria, 15 Copepoda, 26 Cladocera, like the Rhine [16] determined. 70 Rotatoria, 54 Cladocera, 25 Copepoda, 1 Brachiura), again in Latorica river area, [13] 76 Rotatoria, 10 Copepoda, 32 Cladocera. Zooplankton in its natural sites, out of embankment area where there is no significant fluctuations in water level, it was relatively poor in species. 37 Rotatoria, 7 Copepoda, 17 Cladocera.

When you change the conditions of the water column, there were significant changes in the zooplankton community structure and similarity index was low (Ja index). Presented to two sites differing physio-morphological conditions. Zooplankton in the inundated area appears to be incomplete and unstable community, showing signs of ongoing restructuring community.

The EAS principle was used to describe a situation in channel systems [21], especially in the optimization of conditions associated with macrophytes overproduction. It has been prepared on the basis of categorization channels dominance submerged and emergent vegetation and the amount of oxygen [21].

The results of monitoring being done in the upper parts of the multipurpose reservior Domasa has showed a great ability of woody vegetation elimination through its active surface. One square meter of floor contact area reached 60 m^2 of woody vegetation, periphyton was represented by 62 species. In these areas there is a significant elimination of agricultural nutrients and water quality is improving from alpha to beta meso-sabsorobive water quality [24].

When studying the biodegradation of petroleum substances in rivers Latorica and Uh, there was a rapid biodegradation process, so within one year the biodegradation was reduced up to 96.1%. This condition was related to the presence of suspended soil particles and particle of pollution in municipal water, which provides a large area for microorganisms development [5,19].



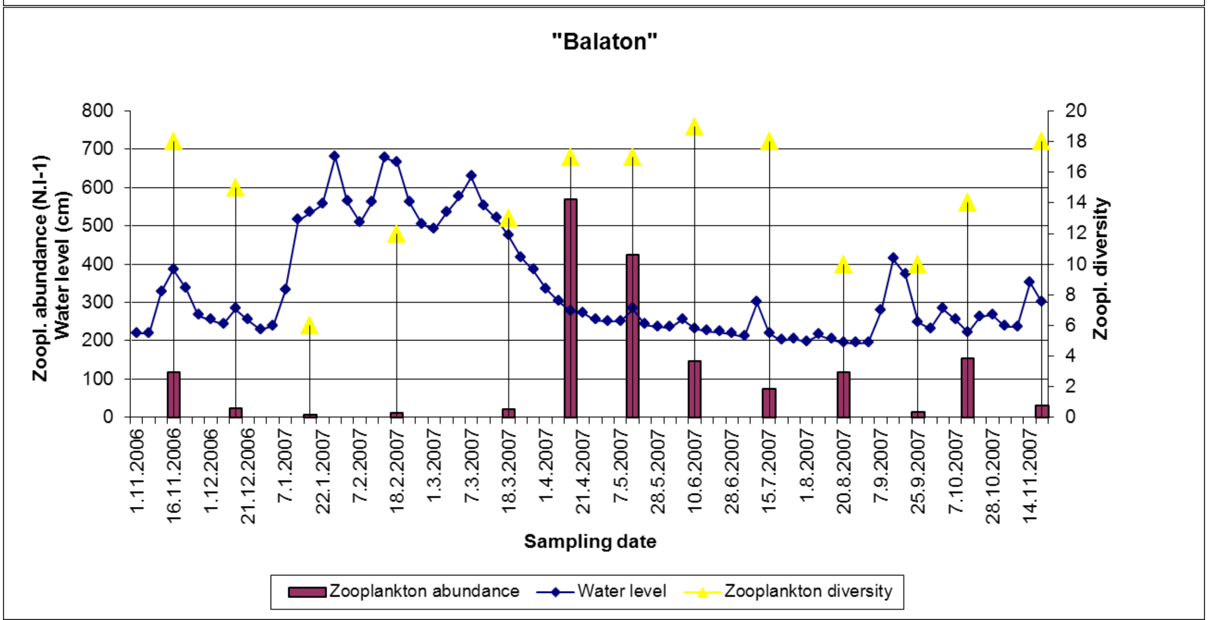


Figure 1, 2 Changes in the water column (cm) and subsequent changes in abundance (n.l^{-1}) and species diversity of net zooplankton [13]

DISCUSSION

In practical hydrobiology there is a knowledge explaining e.g. relationship between catches of fish and morphometric characters of the tanks [3]. Rousnsefell has found indirect dependence proportional between productivity and the tank size [7], Rawson argues that good indicator of productivity is a depth [16], Ryder and all. [8] Bring a term of morpho-edafonic index, which is a relationship between the quantity of substances in water and the water depth. Similarly Zelinka [25] evaluates artificial reservoirs based on morphometric characters. The existence of a "border effect" is also related to the theory of island biocenosis [2]. Those references attest to, directly or indirectly, the existence of EAS explained in many ways.

When interpreting can be explained in the context of the dilution effect as regards abundancie expression to 1 liter, but species diversity clearly shows a significant increase in coupling S.V = K (Fig. 1,2).

The observed increase in cyanobacteria and algae presented in first example is more a tendency that the actual values as there is evident methodological error (Tab.1).

Presented relationship (Fig. 3) expresses the ratio of all contact surfaces to the volume –K and in flowing ecosystems also turnaround time and water changing. -Value A is an interpretation of environmental activity (species diversity, biomass, self-cleaning ability etc.)

These values are related to the energy potential, which is material flow in the ecosystem, which has been already pointed by [4]. The authors come to the conclusion that biological production and intensification is possible to an extent, the greater replenishmend from outside the ecosystem, the greater material flows. Closed energy flows can not give an opportunity to show the biopotential of ecosystems.

The relation S (surface) V (water volume) had already been used by [3]. For flowing water ecosystems is necessary to introduce “water exchange time” – T. More morphometric characteristics, such as the size of the bottom surface, vegetation, microparticles, and water exchange, are gradually added (Eq. 1, 2).

This relationship has a wide validity and application (landscape ecology, soil science, hydrobiology, biogeography), but also in other disciplines.

The principle of this relationship was used in the optimization process.

Overall, the thinking on this problem in aquatic ecosystems divided into phases:

-Empirical [6,7,8,10],

-Proof-existence EAP[1,3,4,15,18,22],

-Modeling functional relationships [awaits us].

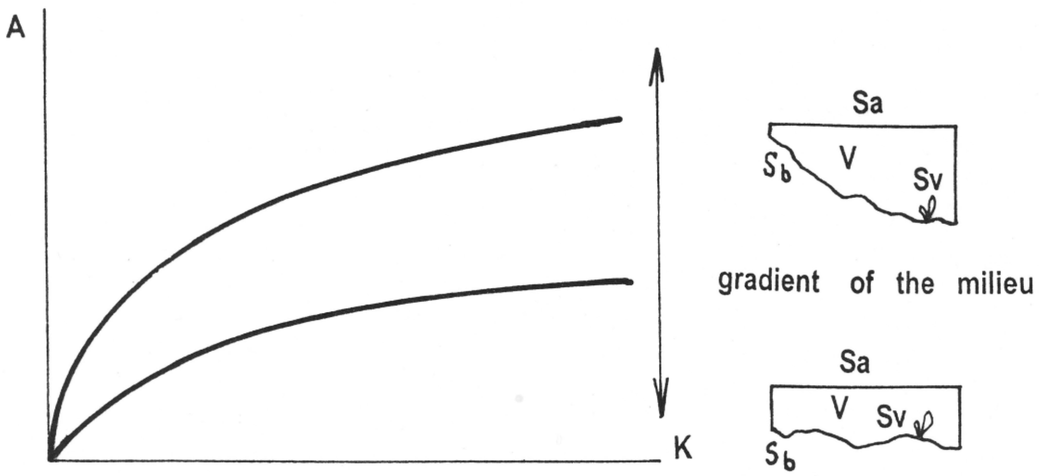


Figure 3 Relation *A*-activity (species diversity (*N*) as well as biomass (*B*), production (*P*), self-cleaning capacity (*Sc*) against the proposed characteristic (*K*)

$$K = \frac{Sa + Sb + Sv + Sm}{V} \text{ (Eq. 1)}$$

$$A(N, B, P, Sc) = K \cdot T \text{ (Eq. 2)}$$

where, *Sa* – surface area of the water body; *Sb* – bottom surface area; *Sv* – vegetation surface area; *Sm* – amount of microparticles; *V* – volume of water; *T* – water exchange time.
The evaluation depends on the depth of the study of the relation water volume (*V*) . unfolded surface area (*S*) . bottom surface area (*Sb*) + air surface area (*Si*) + vegetation surface area (*Sv*) + micro particle surface area (*Sm*), while considering the water exchange time (*T*) and taking into account the environmental gradient. When evaluating that formula, we start from the premise that “the higher the ratio (*K*) is, the greater the possibility of different environmental conditions is, i.e. the higher the number of different species, the quantity of the biomass (*B*), the production (*P*), and the self-cleaning capacity (*Sc*) is. With the enlargement of the boundary areas “*K*”, the efficiency increases as the result of an increased biological activity of the A boundary zone, which manifests itself in an increased diversity of species, productivity, biomass, self-cleaning capacity, etc.
There should have been considered EAS parameters when designing water structures as and take into account the volume of water exchange water, trophy, temperature, biota, and number of microparticles.

CONCLUSION

The results obtained from own measurements and numerous literary sources confirm that the ecological active surfaces- EAS ratio to the volume are the summarizing indicators and constitute one of the methodological issues not only in assessing the capacity of selected landscape elements and their components, but also for the study of the production, stabilization, endurance, and self-cleaning function at the different hierarchical levels of organisms structure.
The proposed EAS values reflect a number of factors and may act as summary indicators, which significantly influence the direction and processes in the ecosystem. They allow to develop the methods of landscape elements evaluation and their components at different levels of anthropic load. Optimization of the country from this perspective is the regulation of bioenergy potentials of different types of landscape elements. In addressing the tasks there still need to be clarified.
- Relations between morphometric and fine structural characteristics of biota in aquatic ecosystems and terrestrial ecosystems respectively their parts,
- Morphometric analysis of the studied objects and biological activity of the boundary zone- EAS.
- Analyze and categorize the relationship between areal size of the bottom, water mirror of the water, biomass, species diversity, production activity.

Attention must be given to.
- Modeling of the relationships between morphometric and fine structural characteristics of biota
- Successional processes and EAS
- Quantified research of ecotone environment.

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SESSION OF POSTERS

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THE DEFUSION OF THE WASTE WATER FROM BIOLOGICAL POLLUTION OF NATURAL WATERS AND LAKES THE PROPOSAL OF APPARATUS FOR DISPOSAL OF CYANOBACTERIA

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Abstract: *The contribution deals with a description of unconventional methods of disposing of cyanobacteria in stagnant waters by electrolysis method. The overall reduction of eutrophication of stagnant water was obtained by non-repayable grant from the EU* in addition to the complementary infrastructure solvers work on machines and equipment on a patented principle*. The first experimental measurements confirmed the success of the method with the possibility of extension to larger water bodies.*

Keywords: *Cyanobacteria, electrolytic method, eutrophication*

INTRODUCTION

In the most industrialized countries we meet with the significant damage of biodiversity in stagnant waters in reservoirs with overgrowth of algae, but especially cyanobacteria-eutrophication. In the directives of the European Union and various international conventions is the term of the eutrophication defined as the excessive growth of the algae and cyanobacteria in the water and on the higher forms of plants due to the presence of excess nutrients in the water, especially compounds of nitrogen and phosphorus. The high content of nutrients leads to an unbalance of the natural environment of waters and to significant discoloration of water levels.

PROBLEM DEFINITION

The mechanisms that lead to eutrophication are comprehensive, continuous and mutually interconnected. The high supply of nutrients into the water body leads to an unbalance of the food chain and to a high concentration of biomass created from phytoplankton in the affected layer of the water. This condition can lead to the creation of the water flower, and direct result of this phenomenon is the excessive consumption of oxygen near the bottom of the water body [1]. Other supporting factors in the process can be divided into two categories depending on whether they are related to the dispersion of nutrients and growth of phytoplankton, or with the oxygen cycle in the water layers close to the bottom (limiting of the circulation of oxygen, light, water flow). Depending on the degree of eutrophication, there can be observed the following adverse effects:

- oxygen deficit,
- decrease of biodiversity,
- production of cyanotoxins.

The members of the Department of Environmentalistics and the Department of Industrial Engineering and Management, Faculty of Mechanical Engineering, Technical University of

Košice solved the research based on the proposal of technologies for disposal of cyanobacteria.

PROJECT DEFINING, STRATEGIC AND SPECIFIC OBJECTIVES OF THE PROJECT

The research is focused on the further development and application of patent technology for improvement of environment surroundings of EU, for the needs of its implementation into the practice, and for solving of the problems of eutrophication of stagnant waters.
The strategic objective of the solved problem is to modernize and to make more effective the support of research and development of universities in order to contribute to the competitiveness of the economy, reducing regional disparities, to creation of new innovative (high-tech) small and medium-sized businesses, to creation new jobs and improving conditions of educational process at the universities.
The methodology of this activity was based on acknowledge of scientific-research base of the participants, and was concerning with the use of the graphic manuals, software, and knowledge of normative, laws and solutions from the environmental problems. The complementary infrastructure and technical facilities for solved problem.
For the cleaning purposes of stagnant waters there were suggested the experimental cleaning apparatus, consisting of patented design special electrodes (Fig. 1), further from the electrolytic reactor and DC power source, as well as software equipment for management of the operational activities of the complexes in experiments (Fig. 2).

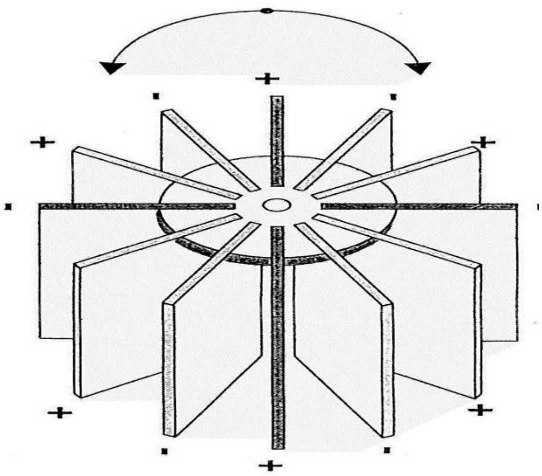

Figure 12: The design of the electrode, patent SR č.282797/2002

Figure 13: Complementaryinfrastructureexperimentalfacility

For the activity of scientific - research station, one of the main objectives, is to be scientific - research base for the solving of the problem of disposal of cyanobacteria in stagnant waters, where it is important to recognize the possibility of micro-organisms in these waters, it means algae, cyanobacteria, green algae or other aquatic animals and in reciprocity (impact of the electrolysis on the water population, frogs, crayfish and others), but also the negative impact of cyanobacteria in this population, but mainly on humans. For these activities were monitored individual long-term water quality parameters and their influence on macro and micro life.

The sub- objectives of these analyses can be summarized in the next steps:

- determining the number of the colony of forming units (CFU) of bacteria, cyanobacteria, pathogenic elements,
- determining of the characteristics of water chemistry,
- measuring of the quantitative characteristics of undesirable substances in water,
- measuring of the adhesion of organic flot for pick- up devices,
- identifying of the method of dispose of organic flota.

All these characteristics were monitored and evaluated by the new laboratory equipment as the plasma analyzer ICPE-9000 (Fig. 3), biological microscope (Fig. 4) and by others apparatuses.

Figure 14: Plasma Analyser ICPE-9000

Fig. 4 Biological Microscope

THE APPLICATION OF THE METHOD

The course of the cyanobacteria in the analysed sites measured by Regional Institute of Public Health Kosice (RÚVZ Košice) is shown in the Fig. 4.

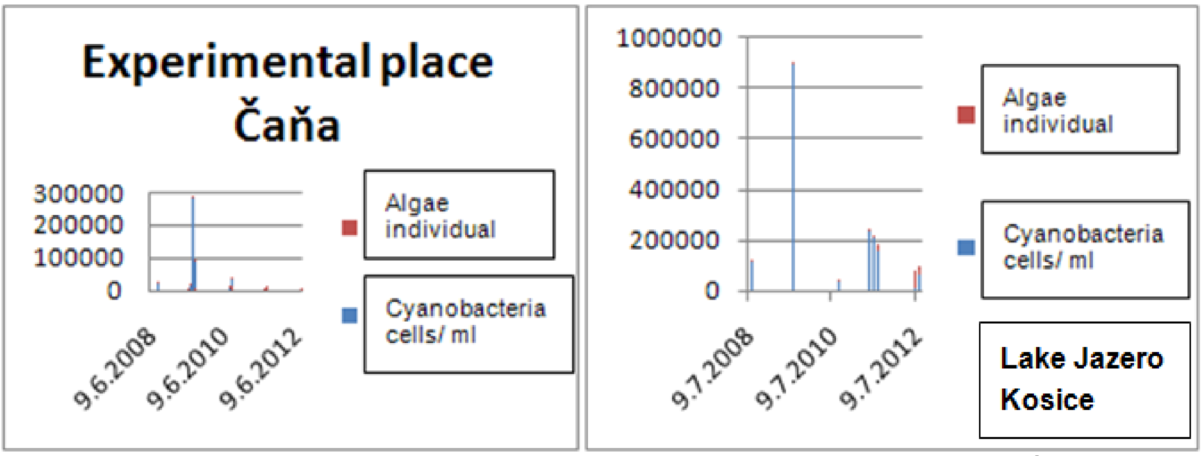

Figure 15: The course of cyanobacteria in the analyzed sites measured by RÚVZ Košice

From these measured values it is clear that the research stagnant waters had rich occurrence of cyanobacteria and algae, caused mainly by climatic conditions.
The experimental apparatus /device and the method of disposal of cyanobacteria has been tested on a lake with an area of 2500 m^2, which was excessively affected by eutrophication, because over the lake was breeding of pheasants and so the supply of nitrogen and phosphorus were excessive. During the experiment, which insist of 30 days, the electrolysis was continuously recorded, and the average voltage values were 24 V and current 4.5A, which represents output about 100W (energetical 2kWh). The view on the experimental place is shown in the Fig. 5.

Figure 16: Store the electrode and its condition after the experiment on the lake

The result of the experiment was recorded as a radical, change in the character of nature bio-life in the lake. In the first phase, the flot was appeared /shown / approximately in thickness10 cm, which disappeared after the first rain and the water became pure. Macro - life during the experiment was not intervene, it means, that fish, frogs, amoebas and daphnia well tolerated the electrolysis.
The disposed green algae and cyanobacteria, which sediment, we subjected them to microscopic observations and results are observed in Fig. 6 and Fig. 7.

In this case, the disruption of the plasma membrane is caused by electrical activity, which led to rupture, since the cell of green algae/ cyanobacteria/ not sustained the high intracellular osmotic pressure. Consequently, after breaking of the membrane of lysosomes in these damaged cells the enzymes decomposed the entire contents of the cells [7].

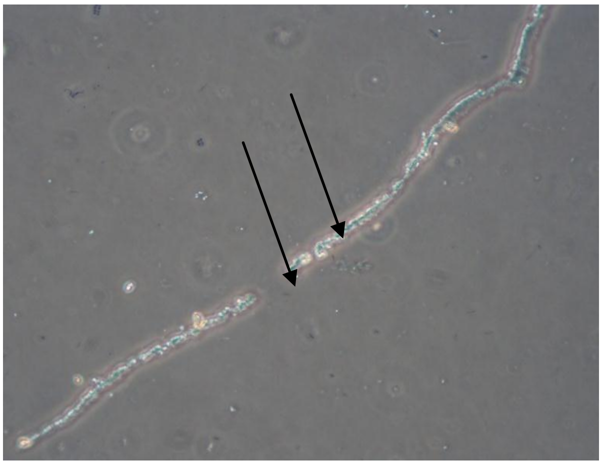

Figure 17: Ruptured fibrous green algae

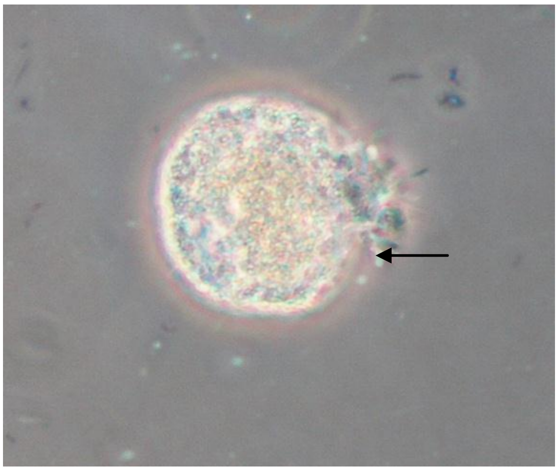

Figure:7 Ruptured cell wall of cyanobacteria

EVALUATION OF THE EXPERIMENT AND CONCLUSIONS

The occurrence of cyanobacteria, water blooms, in the water tanks, in the ponds and in the recreational waters in Slovakia can be well seen especially in the summer months at the steady weather. The consequence is the proliferation of cyanobacteria bloom for motion water, confined waters for fish breeding and recreational use of reservoirs. The pollution of stagnant and little flowing waters, especially in eastern Slovakia, water managers concerned enough, so they are looking for unconventional ways to revitalize these waters. Recreational swimming is at risk of cyanobacterial water blooms, which devalues the bathing water and causing health problems for bathers. In addition to the negative impacts of the use of the tanks, also adverse influence to other organisms that live in the waters. Water blooms of cyanobacteria have the ability to change the physical and chemical properties of water and to release dangerous toxic substances.

CONCLUSION

Those laboratory experiments are promising for the realization of methods of disposal of cyanobacteria in larger bodies of water in real terms. The main impulse that motivated team of investigators to develop and to elaborate the project was the need of practice. Before the implementation of applied research, before they start working with practice, will be created the research and education base, where will be designed of modified equipment that will be verified and will serve as a basis for further technical solutions.
Benefits of this activity primarily consists of an initiating of scientific research experience, especially of water management, construction technology training facilities, which will bring new knowledge and these all will contribute to increasing scientific and research potential of not only the research team. There will be a measurable impact on the results of scientific treatises and a long-term effect of space technology for the creation of new applications of this method similarly as it was at its inception.

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SCREENING OF THERMOPHILIC *BACILLUS* PRODUCING ANTIMICROBIAL COMPOUNDS FROM A HOT SPRING: DBAGH IN ALGERIA

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Abstract: *Thermophilic microorganisms are well-known producer of thermostable enzymes and bioactive compounds that have importance in biotechnological applications. This study was designed to screen thermophilic Bacillus strains with selective antimicrobial potential from an Algerian hot spring "Hammam Dbagh". Strains were subjected to primary screening of antimicrobial activity by plug agar method and secondary screening by agar well method against various test microorganisms. A phenotypic characterization of the strains was realized by a microscopic and macroscopic study, the biochemical characterization was also performed using the API 20E system and others classical methods of microbiology (Mannitol-mobility, respiratory type, catalase, Amylase, Lécithinase, and hydrolysis of casein and Tween 80). In totality, 29 strains were isolated. The results of the phenotypic characterization showed that they are Gram-positive, facultative aerobic, rod-shaped, endospore forming, and thermophiles able to grow under high temperature condition (55-65°C). The biochemical characterization revealed that an important diversity exists between all the strains isolated, they possessed the catalase, and someone possessed lécithinase, able to hydrolysis Starch, Casein and Tween 80. The screening of the antimicrobial activity showed that all the strains produce antimicrobial activities against Gram positive and negative bacteria and sometimes against C. albicans. In fact, according to the phenotypic identification of all strains, they were tentatively assigned to the genus Bacillus sp. but the molecular identification is necessary to determine the species. The identity of the bioactive compound produced is unknown so the analysis by developed techniques such as HPLC, column chromatography and mass spectroscopy is necessary to know there is chemical nature.*

Keywords: Extremophiles, Hot spring, Hamman Dbagh, Thermophilic, *Bacillus*, antibacterial activities.

1 INTRODUCTION

Thermophilic organisms are defined as those that have their optimal growth temperature between 50 and 80°C **(**Brown, 2005**)** and geothermal environment such as hot springs are usually their favorable habitats (Haki and Rakshit, 2003). They have been less explored due to difficulties in isolation and maintenance of pure culture. Therefore, their diversity and biotechnological potential remains to explore from majority of the thermal habitats specifically aerobic spores forming thermophilic bacteria growing at 70°C were characterized for the first time by Miquel (1888). Then a number of strains of the spore forming thermophilic bacteria particularly those belonging to the genera *Bacillus* and *Clostridium* have been studied (Maugeri et al., 2001; Belduz et al*.,* 2003).

In Algeria, more than 200 thermal springs were described, this number increases regularly when one moves eastward.There are few studies on thermophilic bacilli inhabiting the numerous terrestrial hot springs located in Algeria. The aim of the present study was to isolate, characterize and identify a thermophilic bacilli strains producer of antimicrobial activity.

2 MATERIALS AND METHODS

2.1 Sample collection and isolated strains

In this paper, we report the phenotypical characteristics of a thermophilic *Bacilli* strains isolated from hot springs in Guelma the northeast of Algeria. A water sample was collected at a depth between 10 to 15 cm from the surface from 04 Griffin with temperatures of each are listed in the Table 1. The sample was inoculated into nutiant Broth and incubated aerobically at 65°C for days. Positive cultures were plated on nutriant Agar. All isolates were spore-formers and rods morphological were identified by the use of conventional methods for the presumptive identification by biochemical tests.

Table 1: Characteristics of the different griffin when the sample water are collected

Griffin	T (°C)	pH
01	94°C	7,3
02	95°C	7.3
03	89°C	7.65
04	97°C	6.95

2.2 Characterisation of strains

Micromorphology of culture was examined by photomicrography (shape, gram staining, spore staining and motility). Catalase activity was detected by assessing the production of bubbles after the addition of a drop of 10V H_2O_2. Biochemical characteristics were screened by API 20 E, (bioMe!rieux) according to Sharp et al. (1980). Gelatin, starch and casein hydrolysis were tested according to Marteinsson et al. (1996). Lipolytic activity was tested according to Degryse et al. (1978).

2.3 Screening of antimicrobial activity

The antimicrobial activity with thermophilic isolates was determinate against *Pseudomonas aeruginosa* (ATCC- 27853), *Staphylococcus aureus* (ATCC-25923), *Klebsiella pneumoniae* (ATCC-70603), *Bacillus cereus* (ATCC-11778), were used as indicator bacteria in our experiment. A one-indicator fungus was used *Candida albicans* (ATCC10231). Here, we used two technical of primary screening: The first was that the cylinders agar. The thermophilic isolates were grown on nutrient agar plates for 72h at 55 °C. Agar cylinders (6 mm in diameter) were then taken with hollow punch and deposited on the surface of the Mueller– Hinton media (Merck), which had previously been seeded with each germs test. Plates were kept at 4°C for 4h, then incubated at 37 °C for 18–24 h and the activity of each isolate was estimates by measuring the inhibition zones in (mm) (Eccleston et al., 2008).
The second methode was the wells technical. The isolates were grown in nutrient broth for 72 hours then centrifugation was carried out to remove the cells, the supernatant was

retained. Germs test were seeded on Muller Hinton agar, wells were dug by follows with the flat end of the Pasteur pipette and filled with the supernatant of thermophlic isolates. Plates were kept at 4°C for 4h, then incubated at 37°C for 18–24 h and the activity of each isolate was estimates by measuring the inhibition zones in (mm) (Khulana *et al.,* 2012).

3 RESULTS

The hot springs water temperature of Hammam Dbagh (Ghelma) ranged from 95°C to 98°C Those that are easily accessible and are in the vicinity of urban centers are now turned into recreational resorts with hotels, hot spas, and swimming pool. However, very few of these hot springs have been explored for thermophilic bacteria to further expand the search for useful products.

3.1 Characterisation of strains

Altogether 29 bacterial isolates were obtained from water samples collected from hot spring of Hammam Dbagh, Algeria. They were characterized by morphological observation and biochemical tests. Gram staining, microscopic and biochemical characterization revealed it to be a Gram positive rod. The strains tested positive for motility, catalase activity, endospore production. The biochemical characteristic of strains is verry variable. Morphological and biochemical characterization of the isolate indicated it to be *Bacillus* sp. The strains have an various hydrolitic enzymes like proteolytic, hydrolyzes casein into amino acids, property which could be used in potential biotechnological applications.

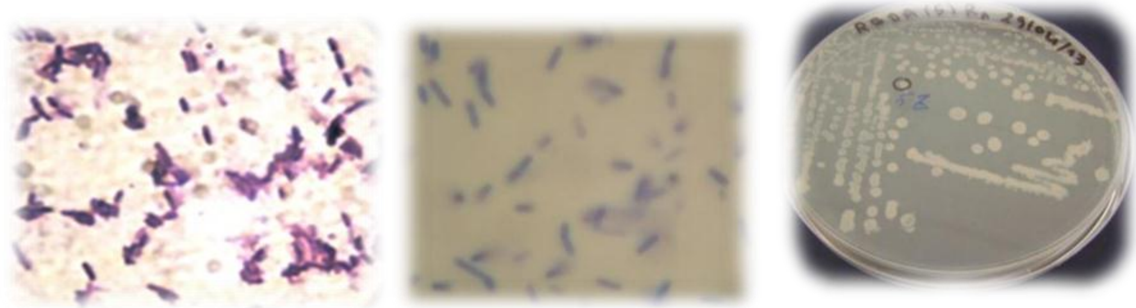

Figure 1: microscopic and macroscopis aspect of strains

3.2 Screening of antimicrobial activity

The results with cylinders agar were mentioned in the Table 2. The largest diameter is 20 mm against *Pseudomonas aeruginosa* and 17 mm against *Staphylococcus aureus*. However, some one of these strains has been inhibitory activities against *Candida albicans*. Other diameter is between 07 and 15 mm against bacteria test. The strains that had an importance antimicrobial activity by the technique of agar cylinders were selected to be the technical essay with wells technical. The results confirm those cylinders but with less diameters because this technical has a primary screening.

4. DISCUSSION

Thermophilic microorganisms have the adaptability to survive in high environmental conditions. Many researchers believed that such capability may be due to their molecular modifications at cellular and subcellular level .In our present study watter sample collected from a hot spring of Guelma – Algeria was investigated for isolated the thermophilic bacteria that have a biotechnological interest.

In this study, 29 bacterial isolates were obtained from water samples and was identified as *Bacillus sp.* by morphological biochimical characteristics and their ability to formed a subterminal endospores. Similar work carried out by Rath (1999) has also reported thermophilic *Bacillus* and *Pseudomonas* species from three hot springs of Odisha, India. Thermophilic and hyperthermophilic bacteria have the ability to produce wide variety of thermostable enzymes. Thermozymes are of great interest for industrial applications (Cowan, 1996).

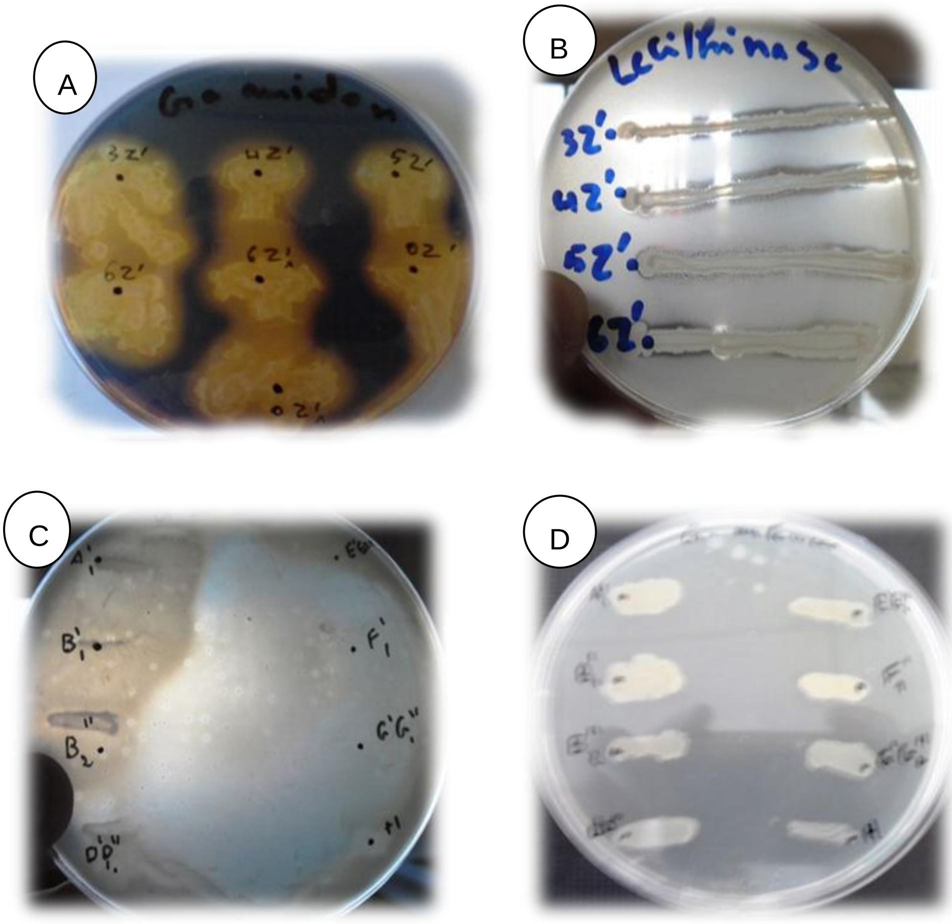

Figure 2: Hydrolytic enzymes extracellulares: A: degradation of strach, B: degradation of lecithine, C: degradation of caseine, D: hydrolyse of Tween 80.

Table 2: Results of the antimicrobial activity of strains isolates against germs test with cylinders agar technic.

strains	*B. cereus*	*K. pneumoniae*	*P. aeruginosa*	*S. aureus*	*C. albicans*
LMB3 901	/	/	**9**	8	/
LMB3 902	/	/	/	/	/
LMB3 903	/	/	**9**	/	/
LMB3 904	/	/	/	**6**	/
LMB3 905	/	**10**	**17**	7	/
LMB3 906	/	9	**16**	9	/
LMB3 907	/	13	9	/	/
LMB3 908	/	8	**15**	7	/
LMB3 909	/	9	**15**	8	/
LMB3 910		8	**15**	11	/
LMB3701	8	10	11	**17**	9
LMB3702	/	8	7	**20**	12
LMB3706	/	/	13	/	/
LMB3705	/	/	13	/	/
LMB3704		7		**20**	13
LMB3703	7	7	14	**17**	8
LMB3707	6	/	9	10	13
LMB 3008	/	/	/	10	/
LMB 3007	/	/	9	/	/
LMB 3006	/	/	7	/	/
LMB 3005	/	/	7	/	/
LMB 3004	/	/	14	7	/
LMB 3003	/	7	15	7	/
LMB 3002	7	9	**20**	7	/
LMB 3001	/	8	**20**	9	/
LMB3501	/	**9.5**	**15**	**6.5**	/
LMB3502	/	**9.5**	**20**	**6.5**	/
LMB3503	**8**	**9.5**		/	/
LMB3504	**7**	**11**	**20**	**6.5**	/
LMB3505	/	**8.5**	**18**	/	/
LMB3506	**7**	**10**	**18**	**7**	/
LMB3507	/	/	**15**	/	/

From the screening study, in the primary was showed antimicrobial power against Gram negative and positive bacteria test and some one of this strains isolates have a power against *Candida.*

These results confirm the results of several previous studies that affirm the ability of thermophilic microorganisms isolated from terrestrial hot springs to produce antibacterial substances active against pathogenic microorganisms (Muriana *et al.,* 1991; Novotny and Perry, 1992; Khalil *et al.,* 2006)

5. Conclusion

The research of thermophilic bacteria from Algerian hot springs with a temperature rang (57-98°C) and pH rang (7.3-7.8) represente a first step in the characterization of thermophilic and hyperthermophilic bacteria affiliated to *Bacillus* genus producing antimicrobial compounds and able to hydrolyze many polymers. However, further studies are needed like phylogenic study and purification of antimicrobial activities that must be done through the chromatographic and spectrometric methods very sensitive and reproducible. hyperthermophilic bacteria possess the unic metabolic and physiological capabilities. Finally, the isolation of such strains from Algerian hot springs extends our knowledge on the microbial diversity inhabiting such extreme ecosystems and their interest in biotechnology.

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SEROTYPING *STREPTOCOCCUS PNEUMONIAE* STRAINS ISOLATED FROM INVASIVE PNEUMOCOCCAL DISEASE AND INVESTIGATING THEIR ANTIMICROBIAL RESISTANCE

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Abstract: *Streptococcus pneumoniae causes severe diseases e.g., pneumonia, meningitis, sepsis.There are more than 91 serotypes of pneumococcus, whose incidence and pathogenity are different. At present PCV10 and PCV13 vaccines are at service to the vaccination of children, for adults vaccine PPV-23 has been developed. The goal of this investigation is to determine the most prevalent, disease-causing serotypes in Hungary, to estimate the coverage rate of pneumococcal vaccines and to examine the antibiotic susceptibility of strains. 490 pneumococcal strains isolated from invasive samples were serotyped between 2004 and 2010. The most common serotypes were 3 (24.29%), 19F (7.35%), 14 (6.12%) and 6A (5.1%). The coverage of PCV13 and PPV-23 was 72.86%, and 78.16%, respectively. The prevalence of PCV7 serotypes has decreased from 51% (2008) to 25% (2010), which validates the efficiency of the vaccination campaign. We measured high erythromycin resistance (31.1%), followed by clindamycin (22,6%), tetracycline (18,6%), trimethoprim-sulfamethoxazole (16,7%), and cefuroxime (14,0%).*

Keywords: *Streptococcus pneumoniae, serotype, vaccine, antibiotic resistance*

INTRODUCTION

Health is our greatest possession, but there are numerous dangers to it, for example the bacteria that are responsible for many diseases. During my work at the National Center for Epidemiology we examined a human pathogen, *Streptococcus pneumoniae*, and investigated the effectiveness of current methods to protect against it.

Streptococcus pneumoniae

Streptococcus pneumoniae is often mentioned as pneumococcus. This name refers to the morphology of the bacteria (coccus, or sphere-shaped) and to the fact that they often cause pneumonia. This pathogen causes very severe, sometimes fatal diseases even in the age of antibiotics. In all age groups except for neonates, *S. pneumoniae* are one of the leading causes of pneumonia and meningitis [1]. They also cause serious sepsis, arthritis, osteomyelitis, peritonitis, bronchitis. Three million people die in each year due to pneumococcus infections [2]. These bacteria are responsible for the majority of otitis media cases during childhood. There are more than two million children under medical treatment for otitis media in Europe each year, and more than forty thousand of them are hospitalized [3]. During childhood, otitis media is one of the most common causes of taking antibiotics [3], that may increase the antibiotic resistance rate in the bacterial population. People over 60 years old are also at risk. Pneumonia is one of the leading causes of death among the elderly, especially the hospitalized inpatients. There are more than ninety-one serotypes of pneumococcus, based on the polysaccharide capsule of the bacteria. These polysaccharides can elicit immune response in the host. The incidence and pathogenity of the serotypes are different.

Antimicrobial resistance

The first antibiotic, penicillin was discovered by Alexander Fleming in 1928. It was used in human medication from 1942. It seemed that pathogenic bacteria can be defeated once and for all. Unfortunately, this did not realize. The first, penicillin-nonsusceptible pneumococcus isolate was described in 1967 [4]. Antibiotic-nonsusceptibility means the bacteria are able to survive after exposure to at least one antibiotic. In case of intermediate susceptibility the drug can inhibit the growth of the organism, but higher or more frequent dosage is necessary for the patients. If the bacteria are resistant, the antibiotic is not effective at inhibiting the microorganism. Pathogens resistant to multiple antibiotics are called multidrug resistant, that often may lead to unsuccessful treatment. The major mechanisms by which *Streptococcus pneumoniae* exhibit resistance are [5]:

- Alteration of the target site, e.g., PBP (Penicillin Binding Protein, the target of penicillin, which is essential for bacterial cell wall synthesis), bacterial ribosome (the target of macrolides).
- Efflux-mechanism, i.e., pumping out of drugs (fluoroquinolones, macrolides, and chloramphenicol) through the plasma membrane.
- Enzymatic modification, e.g., deactivation of choramphenicol.

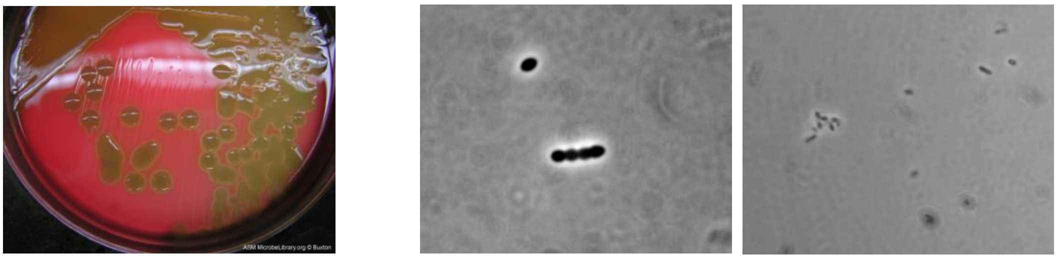
Vaccination

Efficient prevention (i.e., vaccination) is essential because pneumococcus infections are frequent, the complications can be severe, and the microbes can be resistant to antibiotics. The polysaccharides of the common serotypes are used as antigens for active immunization. The first pneumococcal vaccine, which provided protection against four serotypes was made in 1945 [6]. Vaccine PCV7 was on the market in Hungary between October 2005 and April 2011. At present the 10- and 13-valent conjugate vaccines (PCV10 and PCV13) are at service to the vaccination of children, who under the age of two have received it free of charge since 1st of October 2008. For adults vaccine PPV-23 has been developed against pneumococcal infections. PPV-23 contains the polysaccharides of twenty-three serotypes.

EXPERIMENTAL

The IPD (Invasive Pneumococcal Disease) surveillance organized by the Department of Bacteriology of the National Center for Epidemiology was started on the 1st of September 2008. Samples from normally sterile body sites, e.g., blood, liquor, pleural and peritoneal fluid etc. are examined as well as strains from the middle ear.

Streptococcus pneumoniae is a fastidious bacterium, growing best in 5% carbon-dioxide, at 35 °C. It requires a source of catalase (e.g. sheep blood). In the presence of oxygen and on blood agar, pneumococci grow as glistening colonies, about 1 mm in diameter. Serotypes 3 and 37 are mucoid [7]. (*Figure 1a*)



a. b. c.

Figure 18: a. Serotype 3 of Streptococcus pneumoniae on blood agar b. positive and, c. negative result of Quellung reaction (Phase Contrast Microscope, 1200x)

The strains are identified using optochin susceptibility and bile solubility tests to distinguish them from other *Streptococci* [8] [9], then serotyped with Quellung reaction [7]. In the Quellung reaction homologous antibodies bind to the capsular polisaccharide of the bacteria, which change their refractive indexes. A positive reaction can be seen by using phase contrast microscope. (*Figure 1b, c).* Antibiotic susceptibility is measured using disc diffusion and Minimum Inhibitory Concentration Test (MIC Test) [10] [11].

RESULTS

Serotype distribution

From the 1st of April in 2004 until the 31st of December in 2010, 490 pneumococcal strains were serotyped from invasive samples. We found forty serotypes until the end of 2010. The swelling reaction wasn't successful with three isolates, due to the lack of the polysaccharide capsule. The serotype distribution in the whole age group is shown in *Figure 2*.
According to our results, the most common serotypes were 3 (24.29%), 19F (7.35%), 14 (6.12%) and 6A (5.1%).
The prevalence of the serotypes covered by PCV7 was 31.84%. The coverage of PCV13 and PPV-23 was 72.86% and 78.16%, respectively. Against the relatively frequent serotype 6A no vaccine had provided protection until the introduction of PCV 13 in 2010.
According to the investigation of OEK, the prevalence of the nonvaccine-serotypes, which cause diseases in Hungary was 13.47%, including the three nontypeable strains.

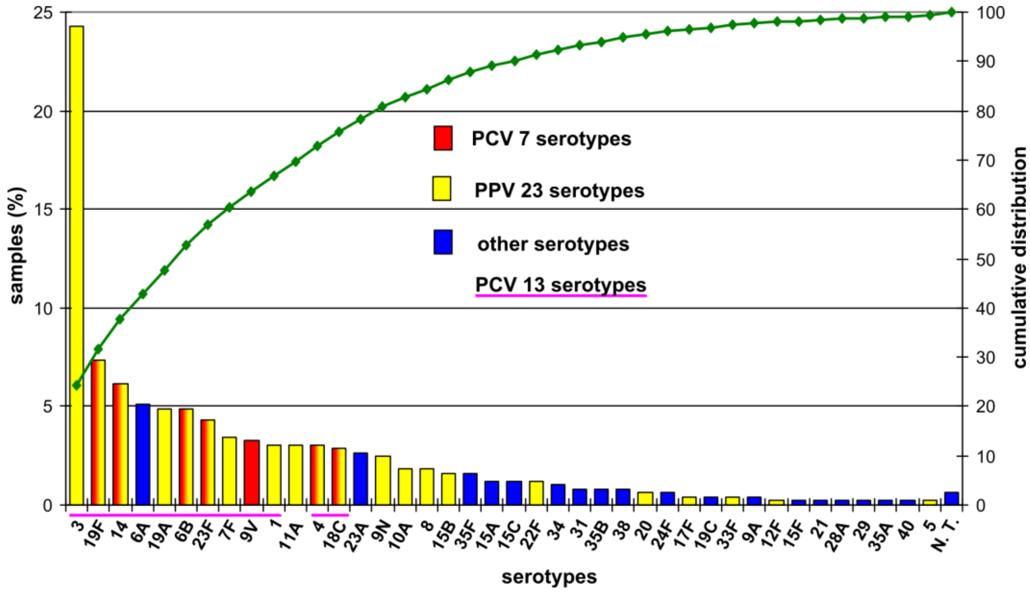


Figure 19: Serotype distribution
N.T. = nontypeable strains

Age distribution

The results verify the increased risk of children under the age of five and the elderly over the age of sixty. We also found a high number of infections in the age group between forty and sixty years. (*Figure 3*)

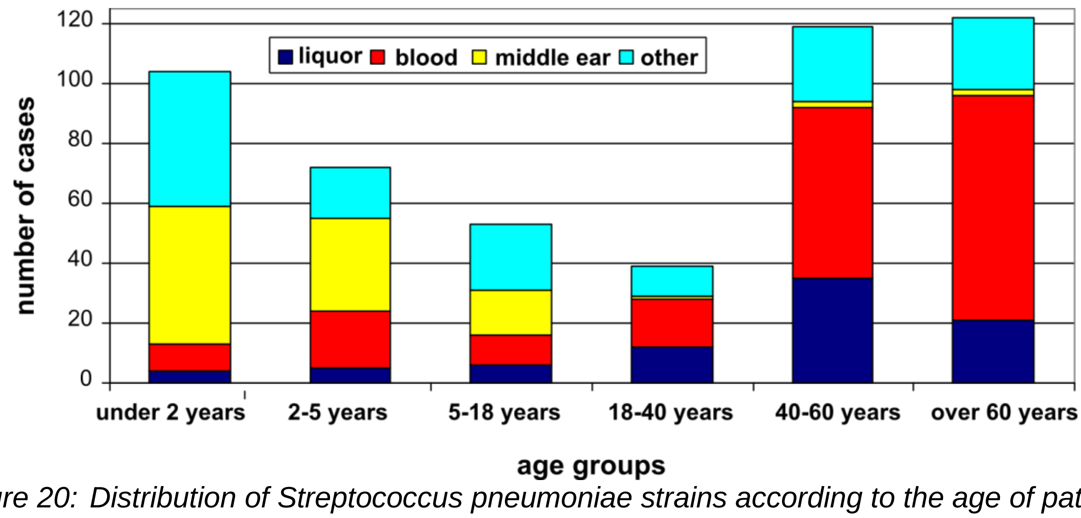


Figure 20: Distribution of Streptococcus pneumoniae strains according to the age of patients and the source of samples other = samples from trachea, pleura, peritoneum and other normally sterile body sites

37.75% of the examined strains were collected from blood, 16.73% from liquor, 19.18% from middle ear. The remaining 26.39% of samples was isolated from other normally sterile body sites. The source of the samples from patients under 5 years and over 5 years was different (*Figure 3*). In the former case the main source of the bacteria was middle ear, whereas the most samples of patient over 5 years were collected from blood and liquor.

For children under 5 we revealed 29 serotypes, from which 3, 19F, 19A and 14 proved to be the most prevalent. 39 serotypes were demonstrable in the age group over 5. We found 3, 14, 6A and 6B the most frequent.

Vaccines efficiency

The efficiency of the vaccines can be measured by the changes in the serotype prevalence. (*Table 1*)

Table 1: Prevalence of pneumococcal vaccines between 2008 and 2010

	2008	2009	2010
PCV 7	51%	32%	25%
PCV 10	59%	43%	32%
PPV-23	81%	84%	79%

PCV7 and PCV10 was developed for the vaccination of children. The prevalence of these vaccines decreased substantially during the interval of our examination.
The vaccine PPV-23 is made for adults, primarily for over the age of sixty against pneumococcal pneumonia and meningitis. The coverage of the vaccine was 81%, 84% and 79% in 2008, 2009 and 2010, respectively.
Figure 4 compares the distribution of pneumococcus serotypes in Hungary before the introduction of the first pneumococcal vaccine (2002-2004) and after the start of vaccination campaign (2008-2010). In the first investigation samples from middle ear were not examined, therefore we also filtered these strains from our data.

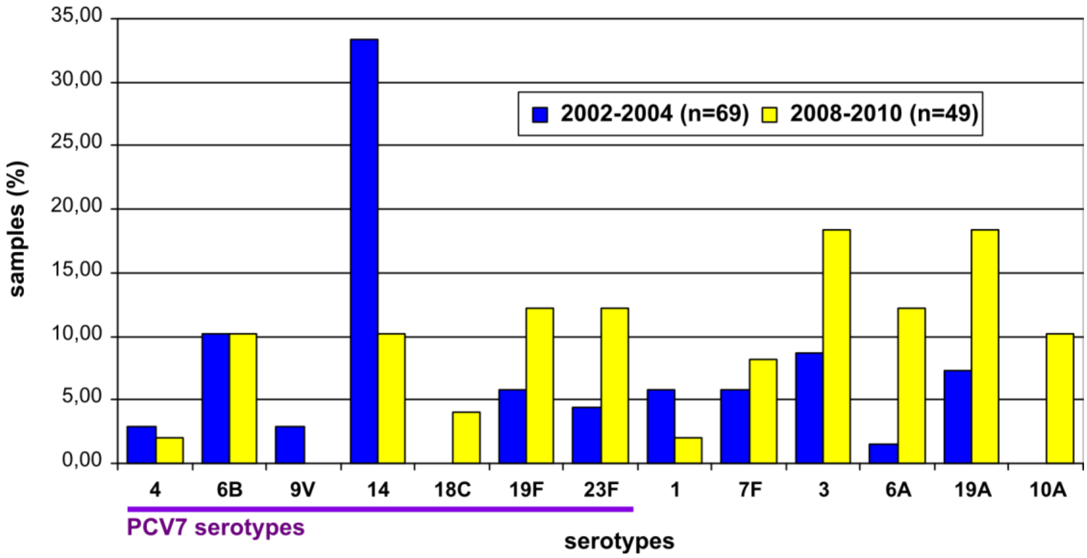


Figure 21: Distribution of the most important S. pneumoniae serotypes before and after the vaccination campaign in the age group less than 5 years.

The proportion of serotype 14 decreased from 33.3% to 10.2% as expected. Serotype 9V was found only twice between 2008 and 2010, in samples from middle ear. Distribution of serotype 4 and 6B were largely unchanged. The prevalence of other serotypes increased, e.g., 19F and 23F from 5.8% to 12.24% and from 4.3% to 12.2%, respectively. Among nonvaccine-serotypes of PCV7, the proportions of 7F, 3, 6A, 19A and 10A grew, but the frequency of serotype 1 decreased.

Antimicrobial resistance

Table 2 shows the antibiotic susceptibility of *Streptococcus pneumoniae* strains. We examined the effect of twelve different antibiotics. We measured high erythromycin resistance (31.1%), followed by clindamycin (22.6%), tetracycline (18,6%), trimethoprim-sulfamethoxazole (16,7%), and cefuroxime (14,0%).

Table 2: Antibiotic susceptibility (percent of strains)

	CRO	CXM	DA	Er	LEV	LZ	MEM	MOF	P	SXT	SYN	TE
S:	95,8	75,2	76,8	68,4	97,3	100,0	97,2	97,8	76,3	69,9	80,3	78,6
I:	2,9	10,7	0,6	0,6	0,0	0,0	2,8	1,6	18,5	13,4	15,9	2,8
R:	1,3	14,0	22,6	31,1	2,7	0,0	0,0	0,6	5,1	16,7	3,8	18,6

Notation*: S=susceptible, I=intermediate susceptible, R=resistant,*
CRO: ceftriaxone, CXM: cefuroxime, DA: clindamycin, E: erythromycin, LEV: levofloxacin, LZ: linezoid, MEM: meropenem, MOF: moxifloxacin, P: penicillin, SXT: trimethoprim-sulfamethoxazole, SYN:quinupristin/dalfopristin , TE: tetracycline.

Penicillin and erythromycin susceptibility of different serotypes is shown in *Figure 5*.

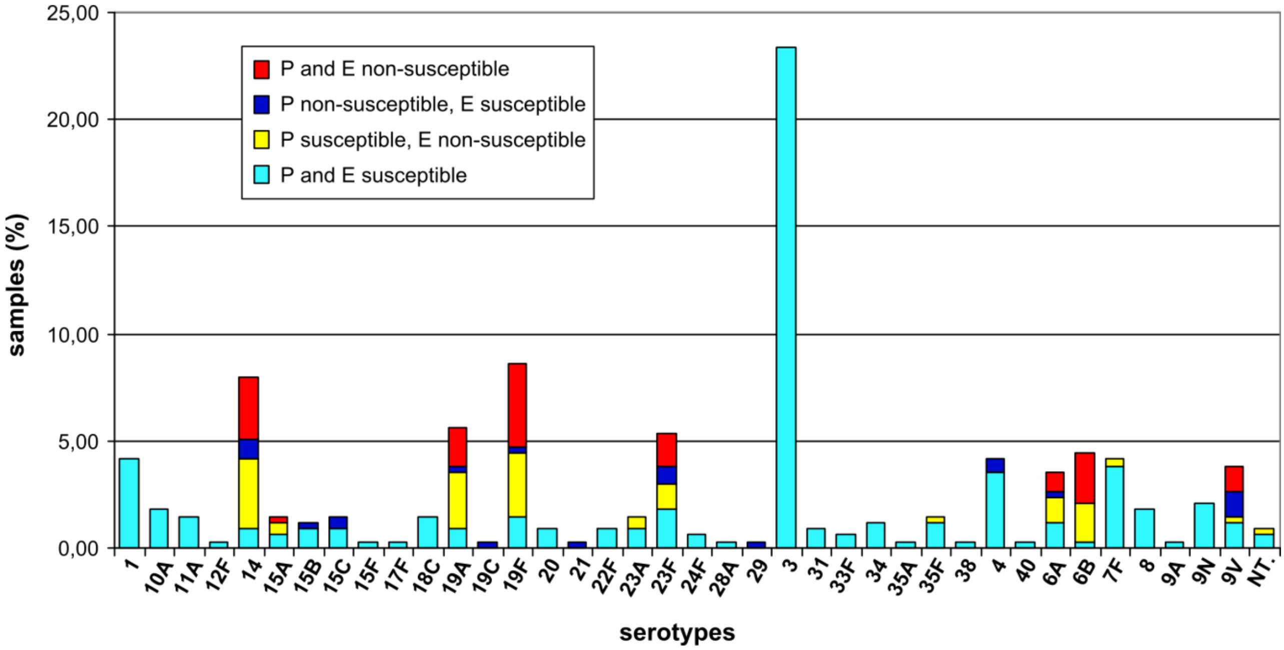


Figure 22: Penicillin and erythromycin susceptibility of pneumococcus strains
Notation*: P=penicillin, E=erythromycin, NT.= nontypeable strains*

23.6% and 31.7% of the strains were nonsusceptible against penicillin (PNSP) and erythromycin (ENSP), respectively. The prevalence of the multiple non-susceptible strains were 14.79%, which make the therapy difficult. The more prevalent strains were more resistant in general, but the most frequent serotype 3 was an exception from that.

DISCUSSION

Serotype distribution

European Antimicrobial Resistance Surveillance System has been examined the distribution of pneumococcal serotypes in Europe since 2003. From the neighbouring countries, the serotype-distribution of Austria was the most similar to Hungary's [12]. Serotype 3 was the most common also in Austria, but not as dominantly as in our examination. In Northern Europe serotype 1 was the most frequent one, but the proportion of serotype 3 increased, just like in the USA [2] [13].

Age distribution

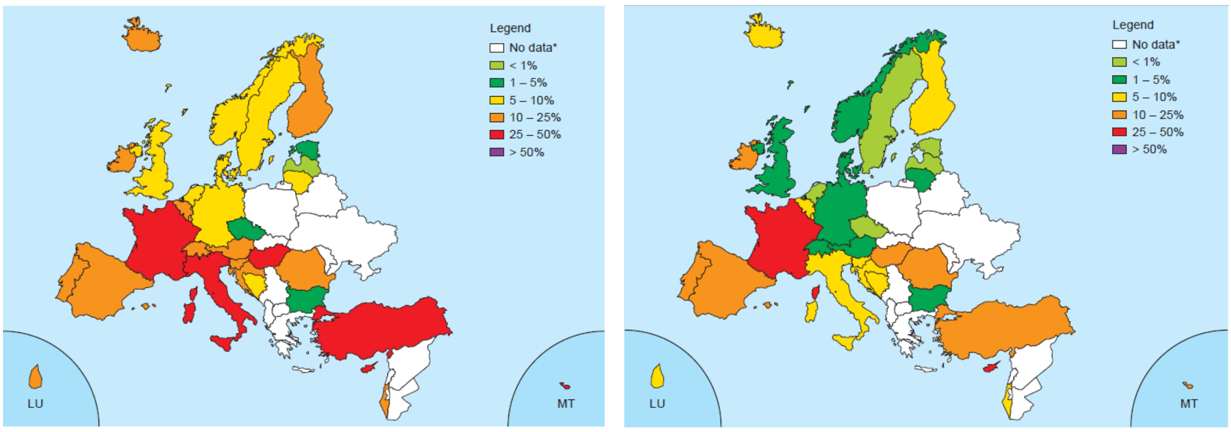
It is well known that children under 5 and elderly over 60 years belong to the risk group, but we also found a high number of infections between ages 40 and 60. According to expectations in childhood it causes otitis media in nearly half of the cases. 75% of children catch otitis media at least once before their third birthday. The infection can be more serious in the elderly age group, because the microbes often pass into the blood or liquor. *S. pneumoniae* is one the most common cause of pneumonia and meningitis in adults.
According to our results the most common serotypes in the age group under 5 years were 3, 19F, 19A and 14. In Austria [14], in Czech Republic and in Poland [12] serotypes 14, 6B and 23F were found as the most frequent ones. In the mentioned countries serotype 19 was also widespread among children, but serotype 3 was only in Austria so dominant as in our investigation. According to EARSS, serotype 1 was the most widespread; in our country, we found it less frequent, just like in Poland and in Germany [12].
In the age group over 5 years the most frequent serotypes were 3 and 14, similar to Spain [12].

Vaccines efficiency

The prevalence of the PCV7 serotypes has substantially decreased between 2008 and 2010 (from 51% to 25%), which validates the efficiency of the vaccination campaign.
The investigations also supported necessity of the introduction of the vaccines PCV10 and PCV13 in 2010. These new conjugated vaccines provide even more protection. PCV13 is efficient against the ten most frequent serotypes in Hungary and against the twelfth (serotype 4) and the thirteenth (serotype 18C), too. This vaccine does not contain the antigen of serotype 11A which was the eleventh in the order of frequency, but includes serotype 5, which was found only once.
In other countries, e.g., in the USA the effectiveness of vaccination seemed to be more unequivocal and even more successful. PCV7 had been on the market in the USA since 2000. The invasive pneumococcal diseases caused by PCV7 serotypes decreased with 77% according to comparison data from 1998 and 2005 [12]. German researchers reported similar results on the pneumococcal surveillance workshop in Wien [12]. In the mentioned countries rates of nonvaccine-serotypes raised only slightly [12].

Antimicrobial resistance

Penicillin-nonsusceptibility is a serious problem, because derivatives of penicillin have an important role in treating meningitis up to the present. Strains with intermediate susceptibility can already lead to the failure of treatment. According to our investigation the rate of PNSP strains was 23.6%, higher than the European average (10%) [2].
The average rate of erythromycin-nonsusceptibility was 15% according to the examination of 32 collaborating European countries. It exceeded 30% only in Hungary and in France. Turkey and Cyprus showed 29%, followed by Italy with 27%. From the 32 countries only 3 reported non-susceptibility rates under 5% (Czech Republic, Estonia and Bulgaria). In Latvia pneumococcal strains with erythromycin-nonsusceptibility were not found [2] (*Figure 6a*). The high nonsusceptibility rates may be attributed to the extensive use of macrolides, based on the high penicillin-nonsusceptibility rates.
The prevalences of the multiple non-susceptible strains were 14.79% in our investigations. This proportion was under 5% in twelve European countries, between 5 and 10% in other ten countries and 10 to 25% in the remaining ten. In France there were many multiple non-susceptible strains (25%), but this had shown a significant decrease in the past 3 years [2] (*Figure 6b*).



a. *b.*

Figure 23:
a. Erythromycin-nonsusceptibility of Streptococcus pneumoniae strains [2]
b. Multiple-nonsusceptibility of Streptococcus pneumoniae strains [2]

CONCLUSIONS

The struggle between humans and pathogens is eternal. Owing to the results of scientific researches our knowledge expands continuously, which is essential to this fight. Antibiotics are not a panacea, the presence of resistant and multiresistant strains draw attention to the importance of prevention, and prudent use of antibiotics. Enormous human suffering can be avoided by preventing the infection.
One possibility of prevention is vaccination. Our investigation also confirms that the vaccination may be efficient; therefore we consider the vaccination of people, who belong to the risk group very important.

Another opportunity to avoid of infection is the destruction of the pathogen, which has got into the environment or to prevent its growth. Certain microorganisms can persist for a long time outside of the human body, even in a hospital. In case of *Streptococcus pneumoniae* the duration of persistence was between 1 and 20 days [15], but other bacteria e.g., *Staphylococcus aureus* or *Enterococcus faecium* can preserve their vitality longer than 60 days [16].
Persons in contact with contaminated furnishings, sheets and clothing of patients can also cross-contaminate other surfaces or humans [17].
The production of antimicrobial finishing treatments is an intensively investigated scientific area that can set back the reproduction of microbes, and may decrease the risk of infection. The preservation of health is an important task even of materials science in our daily lives and in healthcare as well.
There are many antimicrobial substances, and the number of methods to examine their efficiency is also large. Textile coating with metal nanoparticles [18], [19] or plant extracts [20], [21] show strong antimicrobial effects during in vitro tests. In vivo test are also not rare, for example the treatment of patients suffering from dermatitis with silver coating textiles [22] or the use of antimicrobial-impregnated central venous catheters [23].
The goal of our research in Óbuda University is to examine and compare antimicrobial finishing agents, and to work out proposals to improve them.

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IMPROVEMENT OF RHIZOSPHERE BIOLOGICAL ACTIVITIES AND SUNFLOWER BIOMASS BY PGPR INOCULATION

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***Abstract**: A biotechnological procedure in agriculture is based on the activity and biomass of rhizospheric microbial for plant productivity and soil quality. Selection of effective PGPR is the most critical aspect to have maximum benefits from this technology. A single or multiple inoculatants were introduced to the rhizospheres of young sunflower seedlings grown in sterile and unsterile clay loam brown forest soil of 50% moisture content at 28°C in greenhouse pot experiments. Biochemical and microbial activities in the rhizosphere and plant analysis were investigated after 9 weeks of plant growth. Investigations showed statistically significant differences between the tested soil properties and application of selected Pseudomonas fluorescens, Bacillus subtilis, Saccharomyces cerevisiae and Trichoderma viride strains were able to control heavy metal mobilization, pesticide degradation and suppress pathogens in the rhizosphere of sunflowers. Also, results indicated that soil inoculation with selected PGPR strains are required for maximizing sunflower yield and protect plant disease and improve soil quality in the term of soil enzymes and plant nutrient content.*

Keywords: *PGPR, soil enzymatic activities, soil quality, strains selection, sunflower productivity*

INTRODUCTION

The soil root interface (the rhizosphere) plays a vital role in sustaining life in the terrestrial ecosystem in the Earth's critical zone. The rhizosphere is the system of coupled chemical, biological, physical, and geological processes operating together to support life at the Earth's surface and supplies the vital elements to sustain agroecosystem productivity and integrity and food security. The rhizosphere is also the source of the contamination of the terrestrial food chain by inorganic and organic pollutants to endanger human and animal health. The rhizosphere is a narrow region of soil that is directly influenced by root secretions and associated microbial activity. Plant growth-promoting rhizomicrobiota (PGPR) occupy the rhizosphere of many plant species and have beneficial effects on the host plant. Most nutrients and carbon are held in the soil surface, especially, 5-10 cm of the soil profile, and hence this soil layer is important to regulate soil functions and processes (Sparling et al., 2000). Additionally, quality of organic materials strongly influences soil biology and the activity of microorganisms enhances soil properties. Increasing microbial biomass and diversity can contribute to soil microbial activity. Enzymatic mechanism contributes to soil health, which is important for plant productivity. In soil, all biotransformations are related to the presence of enzymes which are produced by microorganisms, soil fauna and plants. Nevertheless, the most of enzymes present in soil are originated from microbial contents and because microorganisms have larger biomass, higher metabolic activities and larger amount of extracellular than plants and animals.
Today, the world relies on increasing crop production to meet the increasing demand for food. However, this trend cannot be maintained due to decreasing cultivable land for rapid

urbanization. In order to increase world food production in a sustainable manner, agricultural land should be amended with amounts of organic fertilizers which is not very costly and make the environment safety. Additionally, more than 50% of the applied inorganic N-fertilizer is always lost through different processes e.g., denitrification and consequently may make environment pollution. Several soil microorganisms promote plant growth, and many microbial products that stimulate plant growth have been remarkable. Several mechanisms by which microbes can act beneficially on plant growth are described. Examples of direct plant growth promotion that are discussed include biofertilization, stimulation of root growth, rhizobioremediation, and plant stress control. Mechanisms of biological control by which rhizomicrobiota can promote plant growth indirectly, i.e., by reducing the level of disease, include antibiosis, induction of systemic resistance, and competition for nutrients and niches. The beneficial effects of these rhizomicrobiota on plant growth can be direct or indirect. Soil inoculation by plant growth promoting rhizomicrobiotas (PGPR) especially species of soil useful microbiotas e.g., *Arthrobacter, Bacillus, Enterobacter, Pseudomonas, Rhizobium, Trichoderma, Saccharomyces*, etc. are model microorganisms to demonstrate influence on plant health. Based on these beneficial plant-microbe interactions, it is possible to develop microbial inoculants for use in agricultural biotechnology. Dependent on their mode of action and effects, these products can be used as biofertilizers, plant strengtheners, phytostimulators, and biopesticides. These biofertilizers is an alternative biotechnological technique in agriculture for enhancing soil fertility by increases N, P, K, and other essential elements for plant growth, is an established technology. The use of the biofertilizers can prevent the depletion of the soil organic matter, too. Soil inoculation with microbial biofertilizers may reduce the application of inorganic N fertilizer and increasing N uptake by plants. It is well-known that inoculation of cereals with plant growth promoting bacteria (PGPB) resulted in increased plant growth and crop yield and acts as biofertilizer and bioenhancer for different non-legumes (Mia et al., 2009). However, there is general agreement that these growth responses were not due to biological N_2-fixation, but also related to the bacterial production of phytohormone, which caused changes in root morphology and physiology that resulted in increased nutrient and water uptake from the soil (Mia et al., 2010). The association of using beneficial soil microbiota (BSM) increased plant growth at different growth stages e.g., enhanced seed germination, increased shoot length, leaf chlorophyll content, total dry matter, grain yield, N content and yield attributes (Biswas et al., 2000). Certain mechanisms are postulated towards BSM which may be involved in growth promoting activities, that is, mobilization and efficient uptake of nutrient, enhancement of stress tolerance, solubilization of insoluble phosphate, induction of systematic disease resistance, production of phytohormones, vitamins and siderophores (Alikhani et al., 2006). One of the factors contributing to the success of biocontrol agent is its persistence in the rhizosphere where control is required. Heavy metals (HMs) contamination of agricultural soils is a worldwide problem. Application of wastewater sludges of high HM contents as organic fertilizer have substantially increased soil HM concentrations on large areas of agricultural soil. Using HMs contaminated soil for the production of food or feed crop yields bears the risk that the contaminants are transferred into food and feed stuffs and ultimately create health risks for humans and animals. The soil biological properties were studied by means of measurements of microbial biomass carbon or nitrogen (MBC) or (MBN), basal respiration (BR), and soil enzyme activities. Soil health status was assessed by simple indices of C_{mic}/C_{org} and BR/C_{mic} in conjunction with bacterial community structures (Zhang et al., 2006). The main aim of this study is to investigate the effects of soil inoculation by microbial inoculant and/or NPK fertilizer on plant growth, C, N and P as well as the biochemical activities content.

MATERIALS AND METHODS

In search of efficient PGPR strains with multiple activities, a total of 88 microbial isolated belonging to the genera: *Pseudomonas, Bacillus, Saccharomyces* and *Trichoderma* were selected for further investigations. These collections were isolated from different rhizospheric soils. The isolates were screened *in vitro* for their PGP traits like production of indole acetic acid (IAA), ammonia (NH_3), hydrogen cyanide (HCN), siderophore, phosphate solubilization and antifungal activity. More than 80% of the isolates of *Pseudomonas, Bacillus, Saccharomyces* and *Trichoderma* produced IAA, whereas only 20% of *Bacillus* isolates was IAA producer. Solubilization of phosphate was commonly detected in the isolates of *Bacillus* (83%) followed by *Pseudomonas* (75%), *Saccharomyces* (55.56%) and *Trichoderma* (46.67%). All tested isolates could produce NH_3 but none of the isolates hydrolyzed chitin except *Trichoderma* isolates. Siderophore production and antifungal activity of these isolates were exhibited by 76.4% of isolates. HCN production was more common trait of *Pseudomonas* (88.71%) and *Bacillus* (56%). On the basis to form a multiple inoculant as PGP activities, 16 of microbial isolates were evaluated for their quantitative IAA production and antifungal activity against three phytopathogenic fungi were investigated. Almost at all concentration of tryptophan (50-500 mg/ml), IAA production was highest in the *Pseudomonas* followed by *Saccharomyces, Trichoderma* and *Bacillus* isolates. *Trichoderma*, *Pseudomonas*, *Saccharomyces* and *Bacillus* showed broad-spectrum antifungal activity on Muller-Hinton medium against *Alternaria* sp., *Fusarium solani*, *Pythium ultimum* and *Rhizoctonia solani*. Expanding the metabolic functions of such isolates, it was found that all isolates were able to degrade 2,4-D and tolerate 80-160 mg of Cd, Pb, Cu, Ni/kg soil and 160-320 mg of Zn, Mn/kg soil prove to be a useful strategy for bioremediation. Further evaluation of the isolates was carried out to exhibit PGP traits on soil-sunflower agroecosystem. The selected strains were identified finally as *Pseudomonas fluorescens, Bacillus subtilis*, *Saccharomyces cerevisiae* and *Trichoderma viride*. The selection was according to their high characterization to laboratory (*in vitro)* experiments. On the basis of recent studies were carried out *in vitro* for selection of PGPR tolerant strains to high temperature, dryness, acidity, heavy metals, pesticides, inorganic fertilizers using solid and liquid media, and then in a greenhouse pot experiments, a microbial inoculant at equal colony forming unit per millilitre ($1.4x10^6$) at equal ratio (1:1:1:1) was introduced to the rhizosphere of sunflower seedlings of 14 days old grown in sterile (SS) and non-sterile (NSS) of acidic (pH_{KCl} 4.72) and low humus content (1.21%) clay loam brown forest soil samples (originated from Gödöllő, Hungary) with 50% moisture content at 28±2°C. Biochemical and microbial activities in the sunflower rhizosphere and plant growth were investigated after 9 weeks of inoculation. The results were present in comparison with control soil and soil treated with recommended NPK (1:1:1) in sterile and non-sterile soil. Plant dry weight (air-dried oven at 70ºC) was determined. The MBC was determined by the chloroform-fumigation–extraction procedure in which C is extracted by 0.5 M K_2SO_4 before and after fumigation (Vance et al., 1987). Soil organic carbon (OC) was determined by wet oxidation with $K_2Cr_2O_7$ according to Walkley and Black (1934) method. MBC was calculated as: MBC = E_C/k_{EC}, where E_C = (OC extracted from fumigated soils) − (OC extracted from non-fumigated soils) and k_{EC} = 0.45 (Wu et al., 1990). The total N was measured by the Kjeldahl method (Bremner, 1982) and MBN was calculated as: MBN = E_N/k_{EN}, where E_N = (total N extracted from fumigated soils) − (total N extracted from non-fumigated soils) and k_{EN} = 0.54 (He et al., 1997). MBP was calculated as: MBP = *EP/kEP*, where *E*P = (total P extracted from fumigated soils) − (total P extracted from non-fumigated soils) and *k*EP = 0.40 (Öhlinger, 1996). Basal respiration (CO_2-evolution) was measured by incubating fresh soil equivalent to

100 g dry weight at 28°C in 1000 ml air-tight jars for 14 days, adjusted to 50% of water holding capacity. In another beaker 50 ml of 1 M NaOH was placed inside the jar in order to trap the CO_2 evolved during the incubation period. 0.375 M $BaCl_2$ was added to NaOH to precipitate CO_2 as $BaCO_3$. The excess of NaOH that did not react with the CO_2 was determined by titration with 1 M HCl. Hydrolysis of fluorescein diacetic acid (FDA) was evaluated according to the methods of Schnürer & Rosswall (1982) and expressed as µg fluorescein/g soil. The method of García et al. (1997) was used to determine the dehydrogenase activity (µg INTF/g soil/h). Urease (µg ammonium/g soil/h) was determined following the method of Nannipieri et al. (1980). Acid phosphatase and β-glucosidase activities were determined (µg p-nitrophenol/g soil/h) by spectrophotometry at 398 nm (Tabatabai and Bermned, 1969). Aryl-sulphatase activity was measured colorimetrically at 420 nm (µg p-nitrophenol/g soil/h) according to (Tabatabai and Bermned, 1970). All experiments were carried out in triplicates and complete randomized block system and the results are presented in the average of the replicates.

RESULTS AND DISCUSSION

Microorganisms in soil are significantly relative to healthy soil and healthy plant because they are a considerable component of soil physical and chemical processes. The soil microbial communities can improve soil structure for PG by enhancing soil aggregate stability. Investigations showed statistically significant differences between the tested soil properties and application of combined inoculant of selected tolerant strains of *P. fluorescens, B. subtilis, S. cerevisiae* and *T. viride* to ecological parameters *in vitro* is able to control heavy metal mobilization, pesticide degradation and suppress the tested plant pathogens in the rhizosphere of sunflower with adjusted mixing ratio (data not shown). Also, results indicated that soil inoculation by effective combination of *P. fluorescens, B. subtilis, S. cerevisiae* and *T. viride* as PGPR strains are required for maximizing sunflower yield in the term of dry weight (Figure 1), MBC, MBN and MBP (Figure 2). Result showed that the plants were healthy and protected from plant disease as well as inoculation the soil by bioinoculant improves soil quality by increasing the organic C, total N and total P (Figure 3) as well as the CO_2-released (Figure 4) and the potential enzymatic activities (Figures 5-7).
Figure (1) demonstrates that the sunflower biomass was significantly higher in non-sterile (NSS) than sterile soil (SS). Also, the microbial inoculant enhanced the plant dry weight more than the application of NPK alone. The best plant production was recorded in combination microbial inoculant and NPK.
This means that the introduced microbial inoculant can be well established in the sterile or non-sterile soils without antagonistic effects, and improved soil quality. Figures 2-4 represented the soil microbial biomass C, N and P, total organic C, total N content and P as well as the CO_2-release, respectively. These parameters were found to be higher in the non-sterile soil with or without application of NPK in the presence of microbial inoculant. Soil respiration has been considered as a basic index for soil microbial activity. Increasing the rate of soil respiration indicates that the soil microbial content is in dynamics and strengthens with it (Figure 4). The application of NPK at this ratio (1:1:1) had no harmful effects on the biological processes in the rhizosphere of sunflower. But usually it improved the activity of the microbial inoculant and significantly improved the soil quality and plant production. So, we found that soil microbiotas benefit to plant growth, can be referred as Plant Growth Promoting Rhizomicrobiotas (PGPR) and not as it is usually said Plant Growth Promoting Rhizobacteria, that because our microbial inoculant contains two fungi the yeast and *Trichoderma* which are capable of promoting plant growth by colonizing the plant root. PGPR

are associated in rhizosphere, which is an important soil ecological environment for plant-microbe interaction and have the potential to contribute with sustainable PGP and function in three different ways: synthesizing particular compounds for the plants, facilitating the uptake of certain nutrients from the soil, and preventing the plants from diseases.

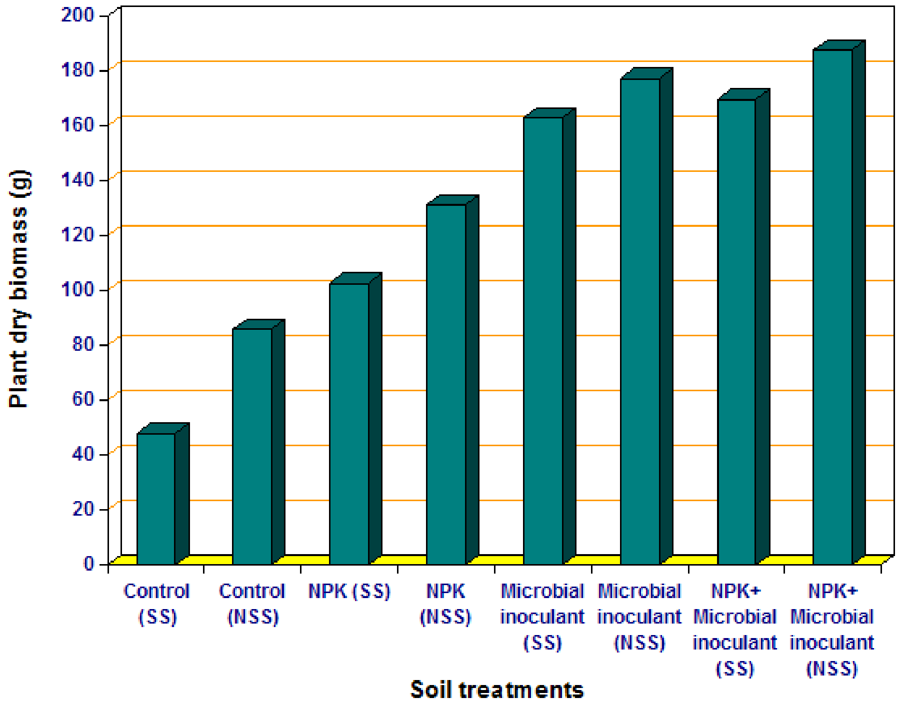

Figure 1 Effects of microbial inoculant and NPK application to sterile (SS) and non-sterile (NSS) clay loam brown forest soil on the growth of sunflower dry weight

The PGP and development can be facilitated both directly and indirectly. Indirect PGP includes the prevention of the deleterious effects of phytopathogens. PGPR can help in solubilization of mineral phosphates and other nutrients enhance resistance to stress, stabilize soil aggregates, and improve soil structure and organic matter content and can retain more soil organic N, and other nutrients in the plant-soil system, thus reducing the need for chemical fertilizer N and P and enhancing release of the nutrients. The conclusion is proved in non-sterile soil where our inoculant can be established and however, colonized well the sunflower roots. Figures 5-7 shows the significant positive effects of the microbial inoculant on soil biochemical activities in the term of potential enzyme activity. Consequently, it was found that the potential enzymatic activities in sterile soil samples were lower than those measured in non-sterile soils. Higher potential enzymatic activities were measured in soils inoculated by the microbial inoculant as well as with the addition of NPK as a stimulator dose to activate the microbial inoculant.

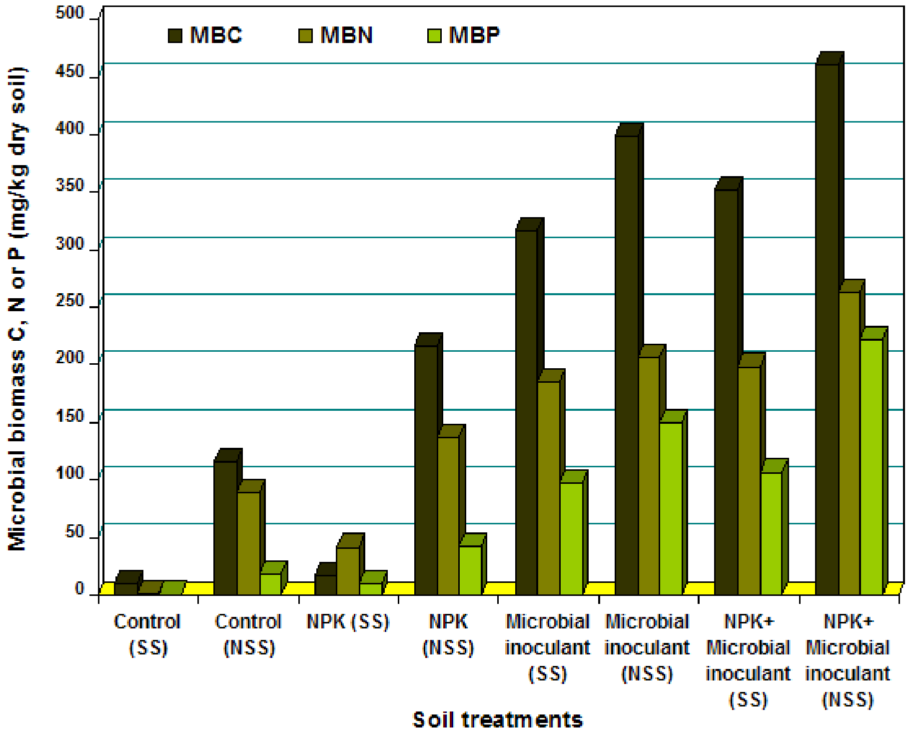

Figure 2 Effects of microbial inoculant and NPK application to sterile and non-sterile clay loam brown forest soil on microbial biomass C, N and P in the rhizosphere of sunflower

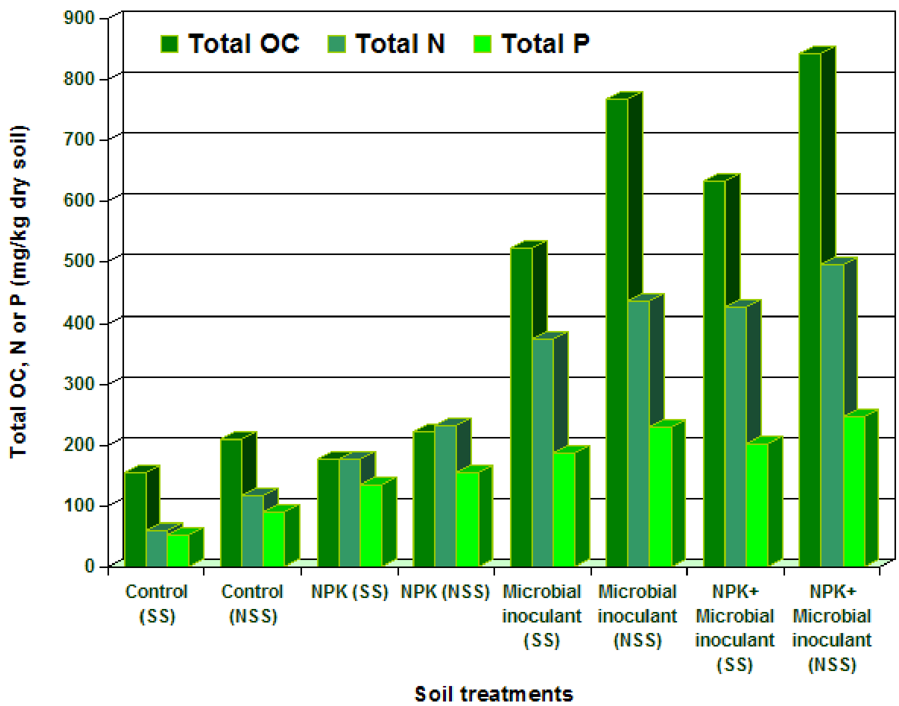

Figure 3 Effects of microbial inoculant and NPK application to sterile and non-sterile clay loam brown forest soil on total organic C, total N and P in the rhizosphere of sunflower

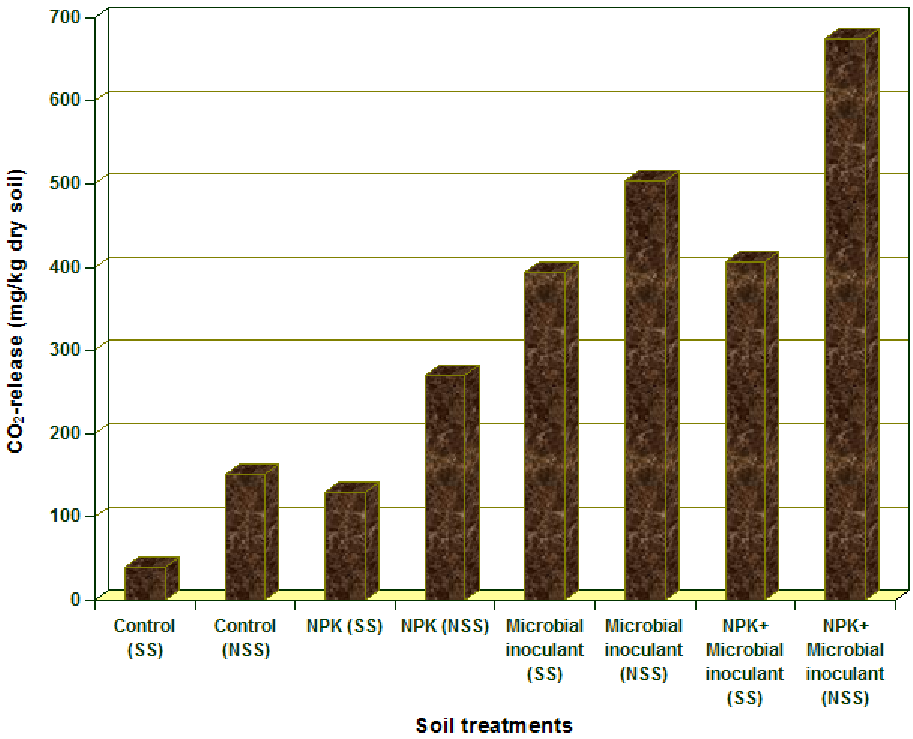

Figure 4 Effects of microbial inoculant and NPK application to sterile (SS) and non-sterile (NSS) clay loam brown forest soil on CO_2-release in the rhizosphere of sunflower

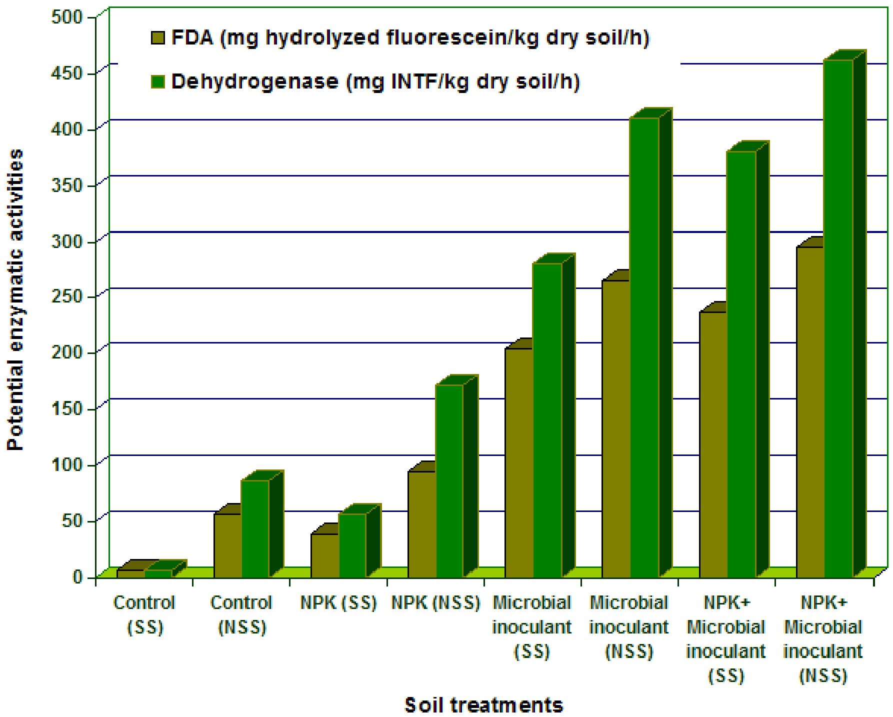

Figure 5 Effects of microbial inoculant and NPK application to sterile and non-sterile clay loam brown forest soil on FDA and dehydrogenase activities in sunflower rhizosphere

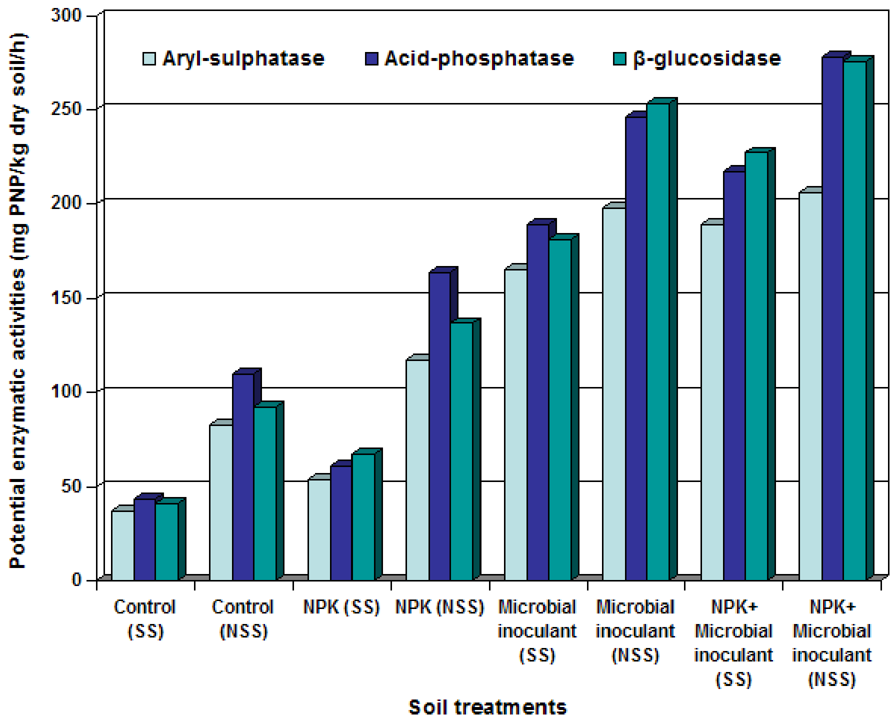

Figure 6 Effects of microbial inoculant and NPK application to sterile (SS) and non-sterile (NSS) clay loam brown forest soil on aryl-sulphatase, acid-phosphatase and β-glucosidase potential activities in the rhizosphere of sunflower

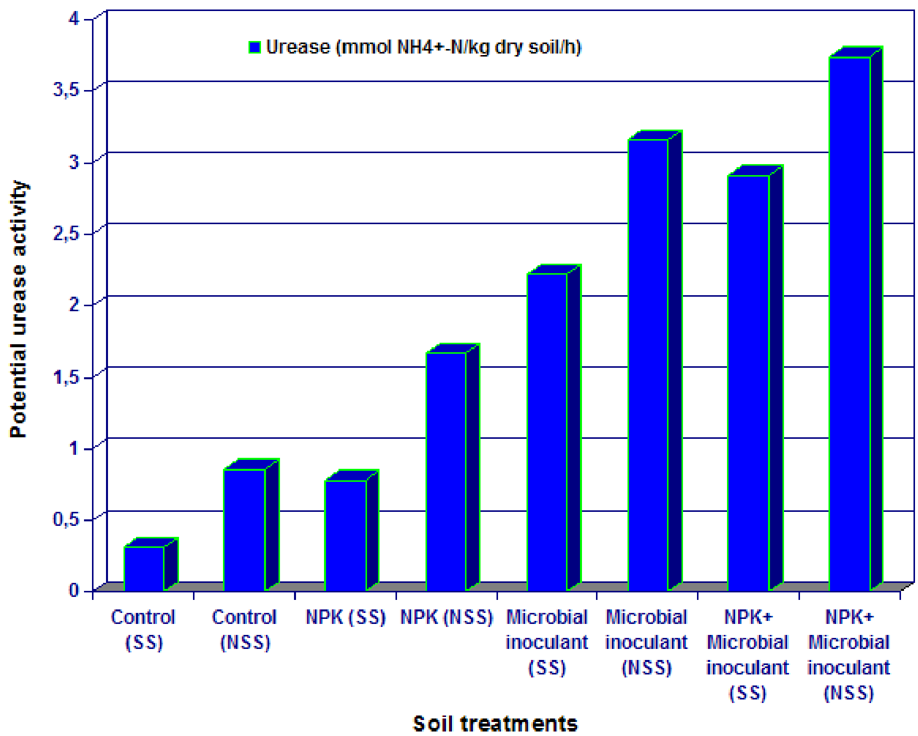

Figure 7 Effects of microbial inoculant and NPK application to sterile and non-sterile clay loam brown forest soil on urease potential activity in the rhizosphere of sunflower

Microorganisms play role in soil nutrient cycling, because their extracellular enzymes have degraded organic matters as their energy source (Khaid et al., 2006). The capacity of soil microbes in decomposition depends on type and abundance of organic materials. Since expression of enzymes is microbial processes, the quantity of enzyme can generally indicate the levels of soil microbial population. Depending on results obtained, we are in an agreement with Hayat et al. (2010) who mentioned that plant-bacterial interactions in the rhizosphere are the determinants of plant health and soil fertility.
However, bacteria and fungi seem to be the most important in soil nutrient cycling because they are the first organisms degrading organic materials as theirs energy source. Soil fertility is enhanced by increasing microbial biomass. Bayoumi Hamuda and Patkó (2012) concluded that a key strategy to enhance the soil inoculant performance to increase plant growth and production is the selection of PGPR strains to improve N_2-fixtion and to survive under stressful soil conditions and greater competitive ability in comparison with usage of agrochemicals. Our result (Figure 1) is agreed with de Souza et al. (2013) that bacteria which are able to colonize plant root systems and promote plant growth and crop yield through a variety of mechanisms.
The continued use of chemical fertilizers and manures for enhanced soil fertility and crop productivity often results in unexpected harmful environmental effects. Integrated nutrient management systems are needed to maintain agricultural productivity and protect the environment. Microbial inoculants are promising components of such management systems (Adesemoye and Kloepper, 2009). Our results (Figures 2-7) are confirmed the results of Adesemoye and Kloepper (2009) at which the level of organic C, total N and P increased by the establishment of microbial inoculant introduced to the soil under different soil conditions.
Ambrosini et al. (2012) concluded that *Enterobacter* and *Burkholderia* were the dominant rhizospheric bacterial genera associated with sunflower plants and inoculation with isolates belonging to the genera *Achromobacter*, *Chryseobacterium*, *Azospirillum*, and *Burkholderia* had a stimulatory effect on plant growth. *Agrobacterium*, *Burkholderia*, *Enterobacter*, and *Pseudomonas* were the most abundant among all the bacterial genera identified. Several of those bacteria could produce indolic compounds and siderophores, to solubilize phosphate, and some could also fix N_2. Some of the isolates tested for growth-promoting effects of bacterial treatment in canola were able to promote plant growth (Farina et al., 2012). Our recent experiments and the present results are in an agreement with conclusions of Ambrosini et al. (2012) and Farina et al. (2012). Zabihi et al. (2010) showed that activities such as production of ACC deaminase and IAA-like products, as well as P solubilization were among the most important activities of the tested *Pseudomonas* sp. Such bacterial effects greatly enhanced wheat growth and yield under greenhouse and field conditions. It has been indicated that the use of organic fertilization with chemical fertilization is a suitable method of providing crop plants with adequate amount of nutrients, while environmentally and economically appropriate.
The role of plant growth-promoting rhizobacteria, arbuscular mycorrhizal fungi, and endophytic bacteria is providing necessary nutrients for plant growth and yield production. Such microbes are beneficial to plant growth through colonizing plant roots and inducing mechanisms by which plant growth increases (Miransari, 2011). On the basis of present results, we can confirm the conclusions of Zabihi et al. (2010) and Miransari (2011).

CONCLUSIONS

The results showed that inoculation of soil with the characterized strains of *P. fluorescens, B. subtilis, S. cerevisiae* and *T. viride* achieved sunflower growth more than those achieved by

NPK chemical fertilization without inoculation, thus highlighting the potential of these strains for formulating new bioinoculants for sunflower yields.

Nevertheless, the novel observations described here represent main points forward in achieving the biotechnological challenging goal for increasing crop productivity by reducing its dependence on the agrochemicals throughout its natural growth.

The future success of the biocontrol industry will benefit from interdisciplinary research, e.g., on mass production, formulation, interactions, and signalling with the environment, as well as on innovative business management, product marketing, and education.

Altogether, the use of microorganisms and the exploitation of beneficial plant-microbe interactions offer promising and environmentally friendly strategies for conventional and organic agriculture worldwide.

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THE CHARACTERISTICS OF NANOGEOCHORAS FORMED ON THE DUMP OF LÚŽENEC IN THE SEREĎ DURING THE LAST 30 YEARS

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Abstract: *The body of dump of industrial conglomerate lúženec at the former plant for nickel production in Sereď can be divided according to the current state into five physiognomically different units (nanogeochoras). Since 1993, when there was a liquidation of the factory for nickel production, the dump was shaped partly by the process of reclaiming and partly in the process of mining. The rest of the dump succumbed to the process of ecological succession. According to chemical-technological analyses the lúženec is very fine material, powdery sand, in which is 97% fractions smaller than 0.1 mm and it contains about 77.8 % of Fe_2O_3, 2.5 - 3.5% of $Cr_2 O_3$, 6-8% of SiO_2, 6 - 8% of $Al_2 O_3$, 2.5 - 3.5% of CaO, 0.6 - 0.18% of $P_2 O_3$, 0.28 - 0.3% of Ni. The composition of lúženec is reflected by content of the aforementioned substances in the soils at particular nanogeochoras.*

Keywords*: lúženec conglomerate, dump, geomorphological processes, soils chemical analyses, nanogeochoras*

INTRODUCTION

The dump of industrial conglomerate lúženec (the waste from nickel metallurgy, processing of laterite iron-nickel ore from Albania with 1 % nickel in one ton of ore, annual production of metal was 3060 tons and annual production of waste was 300 000 tons) is located at Sereď on the Danubian Plain at an altitude of 125 m. It is from aspect of the environment the heavily disturbed space (Klinda, Bohuš, 2011), which is not resolved of ecologically and was left on a self-cleaning ability of the natural landscape. The aim of this paper is to highlight the current structure on the dump of lúženec that has evolved over the last 30 years (after the ending production of nickel) under influence of anthropogenic processes and natural processes in moderate climate zone.

METHODS

Methodology of the work consisted in the analysis of the current structure of landscape the dump through the field research (mapping of relief and the research of geomorphological and successional processes) and analysis samples of the soils. Subsequently using the interpretation of the colourful satellite orthophotographs in high resolution from 2010 (Fig. 1) and through the digitalization the spatial data we are identified five types of nanogeochoras which represent in the present time the horizontal and vertical structure the landscape of the dump.

RESULTS

The primary landscape structure of the dump and its surroundings. The area of the dump is in the landscape of lowland in the moderate climate zone (Lapin et al. (2002).) on the alluvial flat on the river of Váh. The geological substrate under the dump is constituted from the fluvial sandy-clay Holocene sediments with thickness of the 10 to 12 m (Maglay et al. 2005). The dump is situated on this underlying stratum without any isolation. Lúženec is homogeneous material powdery sand has black colour. Originated when processing Albanian laterite iron-nickel ore (amount of sludge is now 6.5 mil. t, it is the rest from 9 mil. t).

Figure 1: Satellite image the dump (©Satelite, 2010)

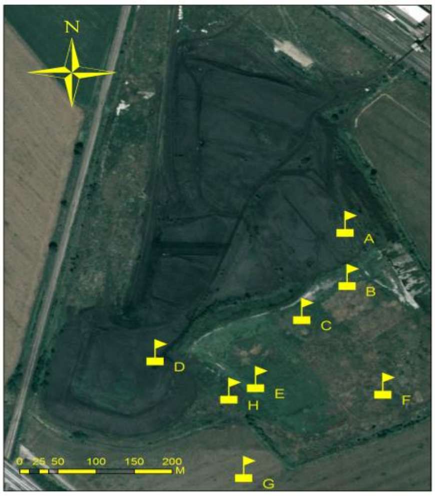

Figure 2: Soil sampling sites (Solár, 2011)

According to the origin is the dump an industrial (Szabó, Dávid, and Lóczy 2010) man-made form of relief on the surface of the landscape. Is it accumulative convex form incombustible with the uneven surface the anthropogenic plain bordered with steep slopes (gradient to 45º).The height of the dump is 35 m (Fig. 3). At the present time the dump is shaped by these geomorphologic processes: anthropogenic activity, water, gravitational and wind erosion. Under their influence is changing the dump its original shape, mostly in the areas without coherent vegetation. The gravitational processes are slow e.g. creeping; the water erosion processes include the erosion of sheet-wash and also the gully erosion. The wind erosion leads into the deflation of metallic dust (Michaeli, Boltižiar, Solár, Ivanová, 2012). The anthropogenic processes include predominantly the mining on the areas without the vegetation. The dump belongs into the warm climatic region (Lapin et al. Landscape Atlas of Slovak Republic, 2002, map 27) which is warm, dry with mild winter. Annual precipitation is 550 mm. Annual shortage of precipitation is 150 mm. The average number of summer days is more than 60 days in the year. Average number of days with snow cover is 40. The area is significant with high number hours of sunshine (over 2100). Predominant air circulation is SE and NW wind (50.2 %). The dump is located in midst of agricultural landscape near the Váh river in the area former metallurgical plant. The collectors of underground waters are in the

depth 2 - 3.5 m under the surface. Soils are represented by Anthropo-Skeletic Leptosols (Šály, 2000, IUSS Working Group WRB, 2006). The vegetation on the dump is metahemerobic (Jurko, 1990) on the toxic industrial waste. In the years 1976- 1980 were built on the dump the sprinkling system against wind erosion and simultaneously was realized an unsuccessful attempt (Banášová, Hajduk, 1984) at reclaiming of the dump. In years 1993 - 94 the part of the dump was a reclaimed through the admixture sludge from beet from the near sugar factory.
Secondary structure of the landscape represents all files of physical elements, which at the present time we find here. Newly created artificial elements of human activities are included into this category as well. Investigation was focused on the characteristic of the dump and its development in the dynamic system at the current landscape in moderate climate zone. Development of the dump is determined by natural factors and by the factors of human activity. Based on the terrain research according to the character of the secondary structure the dump was divided on the five (Fig. 4) physiognomically different nanogeochoras:

1. Nanogeochora on the anthropogenic plateau and on the steep slopes with mining,
2. Nanogeochora on the steep slopes,
3. Nanogeochora on the area the reclaimed part of dump
4. Nanogeochora on the anthropogenic plateau with succession vegetation of trees,
5. Nanogeochora on the form of creeping lúženec around of the dump.

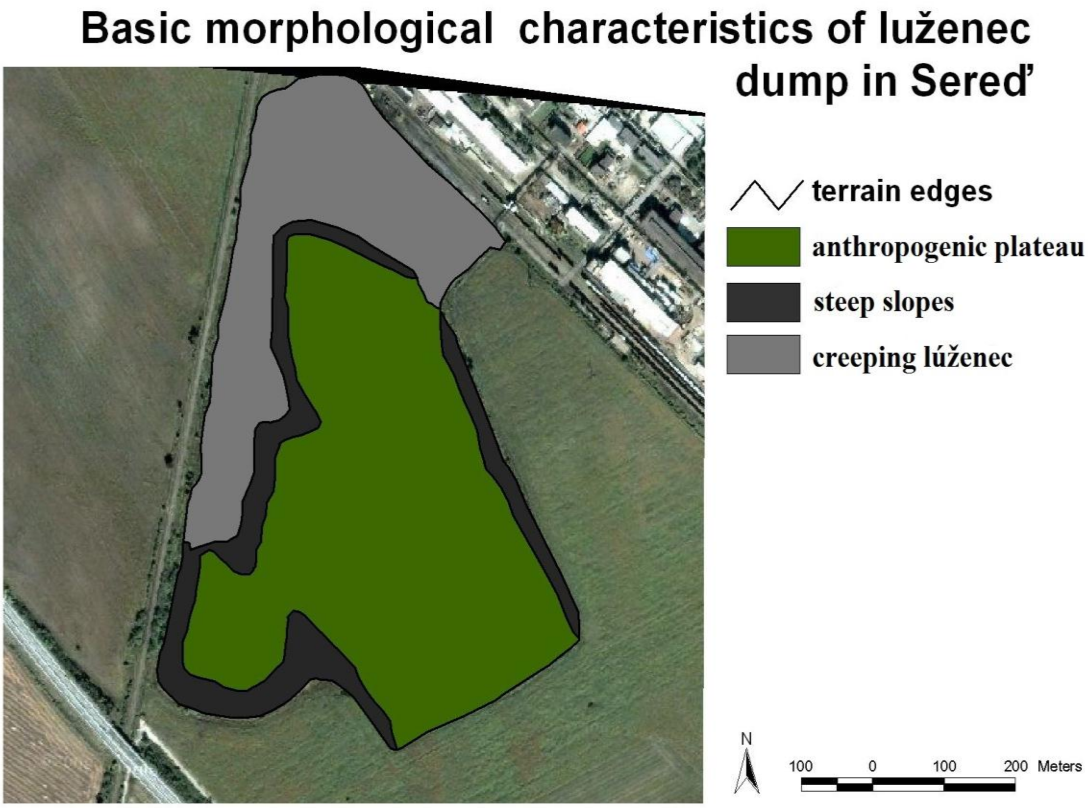

Figure 3: Basic forms of the relief of dump

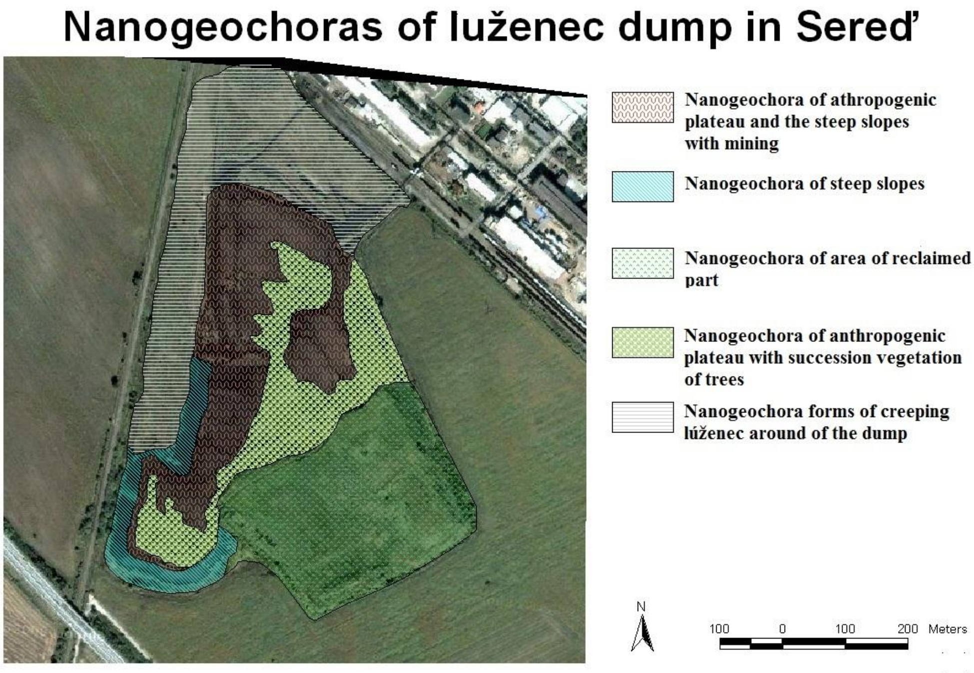

Figure 4: Nanogeochoras on the dump of lúženec

1. Nanogeochora on the anthropogenic plain and on the steep slopes with mining. Inclination of the anthropogenic plain of the dump is 1-10º and on the steep slopes 40°. The inclination is changes daily by frequency of mining (annual capacity of mining is 6. 000 t). Surface of anthropogenic plain is influenced by the mechanisms of mining, by natural processes – mainly by wind erosion - deflation and by water erosion. This part of the dump is almost with no vegetation.

Sporadically is occur small islets (a few decimeters) with *Dactylis glomerata, Poa pratensis* and *Festuca rubra*). The chemical analysis of samples soil is in Table 1 (soil probe D, position on Fig. 2).

Table 1: Chemical analysis the soil in first Nanogeochora

Measurand	**Unit**	**A horizon**	**Method**
Depth [m]		0.2	
pH (H_2O)		8.50	E
TOC	[%]	0.05	HTO
C	[%]	0.74	EA
N	[%]	0.05	EA
Fe_2O_3 T. content	[%]	78	RFS
Al_2O_3	[%]	3.27	RFS
Ni	[mg/kg]	2 920	RFS
Cr	[mg/kg]	24 300	RFS
Cu	[mg/kg]	49.0	RFS
Zn	[mg/kg]	300.0	RFS

Faction ≤ 0.01	[%]	11.1	AS

Source: Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

The area is the biggest source of metallic dust, which influences human organism mechanically, toxically and causes allergies and has carcinogenic effect (Ni and Cr). The soils have a low water capacity, high of evaporation and temperature (in summer 34 ºC) and low content of TOC, strongly alkaline (pH 8.5) with high share of chromium and nickel.

2. Nanogeochora on the steep slopes. Slopes of dump are short and steep with a slope 40-45°. The relief of steep slopes is shaped by erosion of creep, by erosion of water (linear and pluvial erosion), by erosion of wind (deflation). The most prevalent forms of relief on these slopes are the gully (depth of 1.5 - 2.5 m) and erosion rills and small wind forms (dimples of deflation). Slopes are without or the sporadically covered with vegetation. The successional vegetation cover is founded more on the south-eastern slopes, southern and the western slopes are too warm. The chemical analysis of samples soil is in Table 2 (soil probe H, position on Fig. 2). The area is the source of metallic dust. The soils have a very low water capacity and low content of TOC, moderately alkaline (pH 8.25) with high share of chromium and nickel.

Table 2: Chemical analysis of the soil in second Nanogeochora

Measurand	**Unit**	**A**	**Method**
Depth [m]		0.8	
pH (H_2O)		8.24	E
TOC	[%]	0.12	HTO
C	[%]	0.96	EA
N	[%]	0.06	EA
Fe_2O_3 T. content	[%]	74.5	RFS
Al_2O_3	[%]	3.10	RFS
Ni	[mg/kg]	3 151	RFS
Cr	[mg/kg]	21 880	RFS
Cu	[mg/kg]	73.0	RFS
Zn	[mg/kg]	330.0	RFS
Faction ≤ 0.01	[%]	11.9	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

3. Nanogeochora on the area the reclaimed part of dump: occupies approximately 8 ha of the dump. It has flat, slightly sloping surface (3 - 10°). In the marginal part (SE) there are shallow and sloppy depressions. From the aspect cover of vegetation this area not homogeneous. In the vegetation cover dominated the grass. The smaller areas in the wet depressions are covered with *Fragmites communis*. Reclaimed part of the dump is predominantly covered with vegetation of herbs and grass with the dominant species of *Artemisia absinthium*. The experiments of the Institute of experimental biology and ecology of SAS in Bratislava showed that pure lúženec has the worst properties for reclamation but with addition of 20%

sludge of sugar beet (that contains a high proportion of organic remains and $CaCO_3$) profile of the soil on the dump gained better properties. The one part of the dump was sown with grass and herbs according experiments (*Festuca rupicola, Dactylis glomerata, Lolium perenne, Arrhenatherum elatus* and others).

Table 3: Chemical analysis the soil in third Nanogeochora

Measurand	**Unit**	**A**	**B_1 horizon**	**B_2 horizon**	**C horizon**	**Method**
Depth [m]						
pH (H_2O)		7.89	8.62	9.30	8.78	E
TOC	[%]	9.41	2.42	2.16	0.10	HTO
C	[%]	13.30	9.86	10.4	0.79	EA
N	[%]	1.24	0.38	0.33	0.06	EA
Fe_2O_3 T.	[%]	43.90	16.00	11.10	76.40	RFS
Al_2O_3	[%]	2.18	2.02	1.61	3.13	RFS
Ni	[mg/kg]	1 721	971	825	3 053	RFS
Cr	[mg/kg]	12 210	4 044	2 744	21 360	RFS
Cu	[mg/kg]	60.0	111.0	114.0	51.0	RFS
Zn	[mg/kg]	213.0	231.0	213.0	289.0	RFS
Faction ≤ 0.01	[%]	14.2	35.0	39.7	11.2	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

Table 4: Chemical analysis the soil in third Nanogeochora

Measurand	**Unit**	**A**	**B horizon**	**C horizon**	**Method**
Depth [m]		0.8	0.8 – 0.19	0.19 – 0.5	
pH (H_2O)		7.59	8.21	8.68	E
TOC	[%]	9.76	2.99	0.12	HTO
C	[%]	15.80	11.01	0.97	EA
N	[%]	1.16	0.38	0.06	EA
Fe_2O_3 T. content	[%]	28.50	18.70	72.10	RFS
Al_2O_3	[%]	1.77	1.91	3.88	RFS
Ni	[mg/kg]	1 165	641	3 105	RFS
Cr	[mg/kg]	8 937	4 873	20 110	RFS
Cu	[mg/kg]	50.0	31.0	72.0	RFS
Zn	[mg/kg]	155.0	95.0	291.0	RFS
Faction ≤ 0.01	[%]	30.20	46.40	11.2	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

The soils in A and B horizons are faintly and moderately alkaline (pH 7.6 – 8.2) are gray to gray-white color and have a lower percentage of chromium and nickel per kilogram of soil material. They are characterized by a relatively high proportion of TOC 3 - 9.5%. They are characterized by a relatively high proportion of TOC 3 - 9.5% and the ratio of C to N is an average of 14.5 to 1.2. Deeper soil horizons, however, are again strongly to very strongly alkaline (pH 8.7 – 9.3) and the proportion of chromium and nickel in the soil mass is increasing. Their color is gray-black to black. Proportion of TOC, carbon and nitrogen also decreases with depth. Parent rock of soil constitutes the lúženec and according to the chemical analysis has the same characteristics as in Nanogeochoras first and second. Chemical changes in the profile of the anthropogenic soils can be explained through the adding of above listed from sludge of sugar beet. Chemical analysis of the soil shows the different nature of this part of the dump (soil probe E, F, position on Fig. 2).

4. Nanogeochora on the anthropogenic plateau with succession vegetation of trees. This nanogeochora occupies the spaces on the dump, which is situated between first Nanogeochora and the third Nanogeochora. It is represented on anthropogenic plateau in the uppermost part of dump and has an uneven surface. Occur here small micro-relief forms. Vegetation cover is formed by *Populus canescens* and *Populus tremula* with incoherent spacing. In the undergrowth is *Calamagrostis epigejos* and other grass and herbs. Anthropogenic soils are in A horizon moderately alkaline (pH 7.9 – 8. 36). Share TOC is relatively high in the A horizon (4.56%) in the B horizon drops to half (27 2%) and in C horizon is only 0.5%. The proportion of chromium in the A horizon is 13 870 mg/kg. In the B horizon only 2217 mg/kg, but in the C horizon is almost double the proportion of chromium as the horizon A. The situation is similar in nickel content. In the A and C horizons is its content high in the B horizon low (soil probe B, position on Fig. 2). Color in the entire soil profile is black.

Table 5: Chemical analysis the soil in fourth Nanogeochora

Measurand	**Unit**	**A**	**B horizon**	**C horizon**	**Method**
Depth [m]					
pH (H_2O)		7.93	8.86	8.90	E
TOC	[%]	4.56	2.27	0.05	HTO
C	[%]	8.29	11.9	1.05	EA
N	[%]	0.55	0.33	0.05	EA
Fe_2O_3 T. content	[%]	47.0	7.97	74.0	RFS
Al_2O_3	[%]	1.90	0.78	2.99	RFS
Ni	[mg/kg]	1 782	208	3 102	RFS
Cr	[mg/kg]	13 870	2 217	23 110	RFS
Cu	[mg/kg]	30.0	34.0	66.0	RFS
Zn	[mg/kg]	196.0	63.0	301.0	RFS
Faction ≤ 0.01	[%]	17.2	47.4	10.9	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

5. Nanogeochora on the creeping lúženec. This type covers the areas at the foothill of dump on the north, west and north-east (around the dump). It's the anthropogenic surface with small various forms of relief (depressions, small elevation, erosion rills etc.). Vegetation cover reaches 60 -80 % of the area and the occurring species show higher frequency. Wood

species are represented by *Populus canascens, Populus tremula, Betula verrcucosa.* Deep rooting plants are represented by *Cardaria draba, Carduus acanthoides Convolvulus arvensis.* Ruderal species are characteristic for this area and are represented by *Agropyrum repens, Artemisia vulgaris* and *Reseda lutea.* Anthropogenic soils have the similar profile and character as nanogenochoras of reclaimed areas. The dump of waste industrial conglomerate - lúženec is located in the agricultural landscape. The process of deflation gets lúženec into of agricultural soils especially in the vicinity of landfill. By chemical analysis of soils is here excessive content of chromium and nickel. Limit for nickel on sandy-loam soils is 50 mg/kg. The real is in horizon of humus near the dump of lúženec to 198 mg/kg of nickel.
Limit for chromium in the same type of soil in horizon of humus is 70 mg/kg, but real is here 108 - 1443 mg/kg (soil probe G, position on Fig. 2 and soil probe at a distance 600 m from dump). According to the results of the investigation performed by VÚPOP Bratislava the considerable part of these soils should be excluded from the agricultural soil fund. By the influence of strong winds is the lúženec through the process of deflation is transmitted in the planar relief the lowlands within up to 50 kilometres.

Table 6: Chemical analysis the soil in agricultural landscape

Measurand	**Unit**	**A**	**B horizon**	**Method**
Depth [m]		0.5	0.5 – 1.1	
pH (H_2O)		7.20	7.96	E
TOC	[%]	1.78	0.82	HTO
C	[%]	2.07	1.49	EA
N	[%]	0.34	0.22	EA
Fe_2O_3 T. content	[%]	10.6	4.84	RFS
Al_2O_3	[%]	11.6	9.89	RFS
Ni	[mg/kg]	198	45	RFS
Cr	[mg/kg]	1443	81	RFS
Cu	[mg/kg]	41	25	RFS
Zn	[mg/kg]	102	50	RFS
Faction ≤ 0.01	[%]	49.7	30.7	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

Table 7: Chemical analysis the soil in agricultural landscape at a distance 600 m from dump

Measurand	**Unit**	**A**	**C_1 horizon**	**C_2**	**Method**
Depth [m]		0.20	0.40	0.80	
pH (H_2O)		7.72	7.82	7.86	E
TOC	[%]	2.50	1.95	1.50	HTO
C	[%]	3.59	2.76	2.56	EA
N	[%]	0.25	0.19	0.17	EA
Fe_2O_3 T. content	[%]	4.92	5.13	5.06	RFS
Al_2O_3	[%]	12.6	13.1	13.1	RFS
Ni	[mg/kg]	54	53	53	RFS

Cr	[mg/kg]	108	107	100	RFS
Cu	[mg/kg]	33	31	32	RFS
Zn	[mg/kg]	100	94	91	RFS
Faction ≤ 0.01	[%]	46.0	50.4	44.0	AS

Source: ŠGÚŠ, Geoanalytical laboratories, ASL STN EN ISO/IEC, Spišská Nová Ves, SR. Soils sampling in 2011

CONCLUSION

The aim of this article was to identify which from natural and anthropogenic processes at present time have affect to the dump (in moderate climate zone) and what these processes created here. Physical geographical analysis of area was based on field research, mapping the forms of relief and on sampling from soils for chemical analysis. Simultaneously we used the GIS technology. With using these methods we have identified the quality of present structure of the study area. Lúženec is toxic industrial waste and is damaging for environment and also to the health of the population. The research indicates that even after the 30 years after the end of production of nickel the landscape in the area of lúženec dump have not reached equilibrium state. Positive feedback threatens the structure of landscape. The most important natural processes that take place on the dump at present are geomorphological processes water and wind erosion (deflation), what closely related to the physical properties of lúženec (it is a very suitable material for deflation and transport by the wind). The natural geomorphological processes supports and accelerates the process mining of lúženec (private company which bought the dump of lúženec from the state in 1994). Part of the dump was reclaimed (8 ha of 37 ha), the second part succumbed the form of discontinuous islands the process of succession and on the 40-50% of the dump is carried out mining. The earmarked nanogeochoras provided image on the current structure of the dump and shall inform on the all processes that is currently apply to dump.The most important problem is spreading - emissions of the metallic dust from the areas which are not covered by vegetation, what causes contamination the atmosphere, the soils and underground and surface waters.

The phytoremediation the dump of lúženec given for the amount of material is impossible. Processing of lúženec with help of microwave vitrification is a new and prospective method, but is very expensive. This method is based on stabilization of dangerous elements by transformation into vitreous, glassy material at high temperature – over 1 000 ºC (it is also necessary to take into account the waste amount). Minimal reconstruction of the dump which could solve the emissions of the metallic dust is cover the landfill by vegetation, but the dump is private property, where mining is carried out. The production of nickel and cobalt was terminated and finished also the source of contamination, but pollution does not disappear itself, it still persisting.

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EVALUATION OF THE ENVIRONMENTAL LEVEL OF PASSENGER CARS

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Abstract: *Cars are already more than a century indispensable part of people's lives. Currently rides down the road all over the world, about 900 million cars. The growing automotive industry leading hand in hand to increasing of the pollution in the environment. The paper deals with identifying and comparing key parameters of selected types of passenger cars and then evaluation of their environmental performance. By the evaluation has been used the method of comparative analysis, which is one of the tools used in the design of the products with respect to their environmental aspects.*

Keywords: *ecodesign, evaluation, environmental level, passenger car*

INTRODUCTION

The comparative analysis method is used primarily to assess the level of environmental products, which should eventually help in deciding where to make a change of some properties so that the environmental level of the given product is more favourable. Environmental level of each product is determined in the initial (conceptual) stage of its life cycle. The assessment of the environmental level, which is stated in the article, was based on the comparative analysis method, which is designed for this kind of assessment of the already existing products. The article is focused on the assessment of environmental level of passenger vehicles of brands HONDA (Fig. 1) PEUGEOT (Fig. 2) CITROEN (Fig. 3) SKODA (Fig 4). The chosen automobiles are of the same category (lower class) labelled "hatchbag", the same engine volume 1,4l and with gasoline-powered engine. Assessed requirements (properties) of zero and certain level are listed below in Table 1.

Figure 1 Honda Civic - 1.4

Figure 2 Peugeot 206 - 1.4

Figure 3 Citroen C3 1.4

Figure 4 Škoda Fabia 1.4

Table 1 Table of the comparative analysis for the assessment of the environmental level of the object

J	Name of the requirement	Requirements Pj	Significance factors Gj	Evaluated subjects			
				V1	V2	V3	V4
				HONDA Civic - 1,4	PEUGEOT 1,4 16 V	CITROEN C 3 1,4 i	ŠKODA Fabia 1,4
				Properties V			
Requirements and properties of zero level							
1	Coefficient of air resistance	0,32	0,75	0,32	0,32	0,35	0,33
2	CO emissions	0,48	0,75	0,48	0,52	0,54	0,53
3	NOx emissions	0,2	0,75	0,2	0,22	0,23	0,22
4	HC + NOx emissions	0,24	0,5	0,24	0,26	0,27	0,26
5	CO_2 emissions	139	1	139	147	145	151
6	Weight content of Al alloys	6,9	0,75	8,3	7,2	6,9	7,1
7	Emergency weight	1014	1	1240	1049	1014	1060
8	Noise of vehicle	68	0,75	72	79	68	74
9	Combined fuel consumption	5,9	0,75	5,9	6,1	6,3	6,5
10	Weight proportion of plastics content	6	0,75	6	6,7	7,3	6,8
Requirements and properties of certain level							
11	Number of gears in gear box	5	0,1	5	5	5	5
12	Tank volume	50	0,25	45	50	50	50
13	Maximum speed	179	0,1	169	179	170	174

STARTING POINTS FOR THE METHOD OF COMPARATIVE ANALYSIS

1. Selection of the assessed products.
2. Selection of the properties/requirements with zero level, i.e. such requirements/properties value of which should get closer to zero requirements (Tab.1) [2,3].
3. Selection of properties/requirements with certain level, i.e. such properties/requirements, value of which is bound to the certain level of the requirements (Tab.1) [2,3].
4. Estimation of the significance factor, i.e. allocation of the number of the points to the corresponding properties/requirements according to the following order [2,3].:
   - decisive requirement Gj = 1,00
   - very important requirement Gj = 0,75
   - important requirement Gj = 0,50
   - less important requirement Gj = 0,25
   - insignificant requirement Gj = 0,10
5. Defining the values of the properties/requirements for the assessed product. In frame of the education process the students exploit the accessible data stated by the manufacturer of the assessed product.
6. Calculation of the assessing number ZCi according to the formula

$$ZC_i = \sum_{j=1}^{m1} \frac{G_j\left(P_{j-}V_j\right)}{P_j \sum_{j=1}^{m1} Gj} 100 + \sum_{m1+1}^{m2} \frac{G_j\left(V_{j-}P_j\right)}{P_j \sum_{j=1+m1}^{m2} Gj} 100$$

- Where:

Pj - j[th]- requirement for object,

Vj – j[th] property of the object, when j = 1, 2, m1, where m1 is number of the properties (requirements) with so called zero level and m2 is number of properties (requirements) with so called certain level,

Gj – factor of significance for jth requirement, where m is total number of requirements and where holds the following formula: 01 ≤ Gj ≤ 1,0 [2,3].

7. According to the results of the assessing number ZCi assessed is the worst product, which has, based on the calculations, the highest (negative) impact on the environment.

ASSESSMENT OF ENVIRONMENTAL LEVEL OF PASSAGER VEHICLES

Based on the theoretical results of the comparative analysis method and the pre-defined requirements with certain and zero level stated in Table 1, we came to the values which evaluation figures are as follows:

$$ZC_1 = ZC_{1(1)} + ZC_{1(2)} = ((\ -5{,}409\ ) + (\ -6{,}797\ )) = -12{,}206$$
$$ZC_2 = ZC_{2(1)} + ZC_{2(2)} = ((\ -6{,}943\ ) + (\ 0{,}0000\ )) = -6{,}943$$
$$ZC_3 = ZC_{3(1)} + ZC_{3(2)} = ((\ -7{,}685\ ) + (\ -1{,}117\ )) = -8{,}802$$
$$ZC_4 = ZC_{4(1)} + ZC_{4(2)} = ((\ -7{,}924\ ) + (\ -0{,}621\ )) = -8{,}545$$

After performing the total number of the requirements with zero and certain level of requiremets, we will choose the value farthest from zero which is in our case characteristic for the value ZC_1. The evaluation number ZC_1 **= -12,206** belongs to the passanger vehicle HONDA civic – 1,4. This result suggests that this car has a more favourable environmental level than other compared automobiles (Fig. 5).

Table 2 Unmet requirements expressed by numerical form

Evaluated cars	Unmet requirements
1. HONDA Civic	**6, 7, 8, 12, 13**
2. CITROEN C3	**1, 2, 3, 4, 5, 9, 10, 13**
3. PEUGEOT 206	**2, 3, 4, 5, 6, 7, 8, 9, 10,**
4. ŠKODA Fabia	**1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13**

The numbers of demands that automobiles failed to fulfil are listed in the Table 2. The number of the unfulfilled demands influenced their order in the table. The fewest unfulfilled demands appertain to HONDA civic, which concurs with the result of its evaluation number.

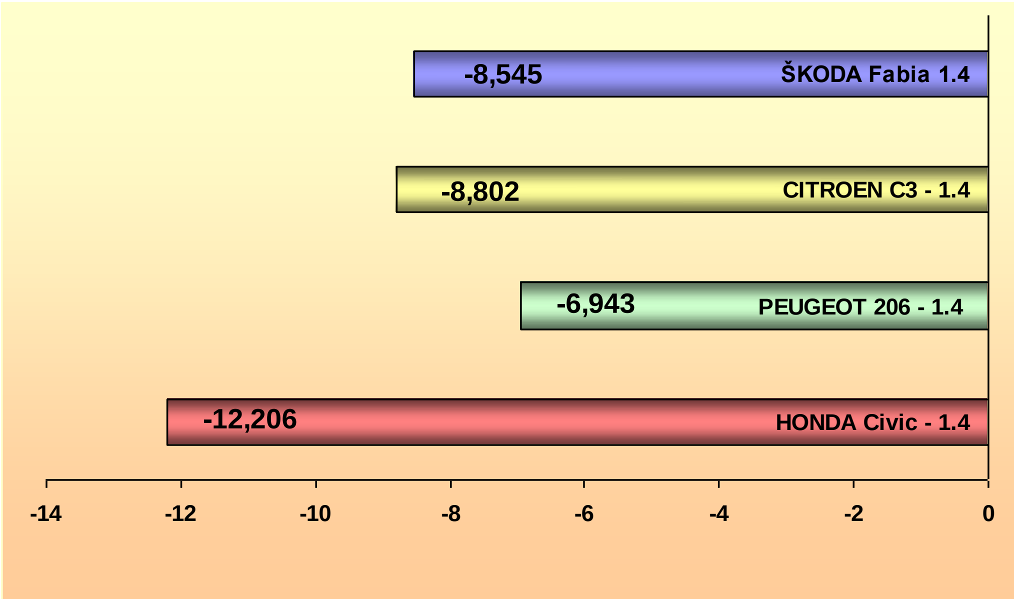

Figure 5 Graph of the results of the calculations of ZCi

CONCLUSION

Negative values of evaluation numbers that we got in the calculation of all evaluated objects reflect the fact that environmental level of these products differs from the created ideal (theoretical) level which is the result of the already mentioned process. The mentioned automobile HONDA Civic approached the most environmentally-friendly level.

Number of unmet demands does not have to immediately mean negative evaluation number. It depends on what significance factors are assigned to individual requirements.
Even more perfect methodology can give biased results if the data relating to objects are distorted. In this case, the data that were used were available and can be found in the technical data of the automobile produced by a specific manufacturer.

In conclusion, it is appropriate to assess many either engineering or non-engineering products and subsequently, based on the result data, to suggest appropriate changes of the products´ properties in a way that we get a draft of the same product with environmentally superior level.

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DISTRIBUTION OF PARTICULATE MATTER FROM INDUSTRIAL SITE

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Abstract: *This paper is focused on the problem of particulate matter in the air, which is currently very topical and discussed. The purpose of paper is distribution of particulates from quarrying to the environment. The source of particulate matter was chosen surface stone quarry near populated areas. The aim was to creating a mathematical model of the distribution of particulate matter from the source to the surroundings. Consequently, it is possible to assess the impact of industrial site to population near the quarry and if it is necessary to propose measures to eliminate escape of particulate matter from industrial site.*

Keywords: particulate matter, distribution, industry.

INTRODUCTION

Solid aerosols are an integral part of the ambient air and do not constitute a health risk for humans. The problem arises when there is site, which produces a lot of particulate matters and they have influence to people who live near by the site. The risk is even greater if the site is open source of particulate matters, for example surface mining and quarrying.
Regard to currently increasing mining was chosen quarry, in which there is quarried building stone. The reason is that this type of stone is used for building modifications and river beds to avoid flooding, which is currently quite debated topic.
The aim of this paper is to highlight the issue of the distribution of particulate matter from open source to the environment and the potential impact on the human health. And then there can be create a mathematical model of immission map.
The immission map, respectively mathematical model of the air pollution situation is to obtain information of the direction of distribution of particulate matters and also the dispersion of particulate matters from the source of emissions in ambient air. It is a static visualization of pollutants.

DESCRIPTION AND LOCATION OF SITE

The site, in which the measurement is realized, is focused on mining porphyrite diorite (andesite), from which the various treatment processes produces crushed stone. There is a two-shift operation, which operates 43 employees.
The operation of the quarry is located in eastern Slovakia, about 200 m northeast of the nearest village. The actual mining area is located from 600 to 1200 meters in the same direction. Nearby there are no other mineral deposits.
Operation is fully automatic. Staff provide only checks and inspections of individual parts of equipment and, if necessary, they do maintenance and repair (equipment must be turned off at the time of repair), further ensuring quality control of stone, cleaning of premises and keep records of the operation. Every employee has the necessary and appropriate PPE.

Technology in the production process can be divided into several main parts: mining, primary crushing, secondary crushing, inter-reservoir, tertiary crushing, final crushing and screening. The main sources of particulate matters as the most significant contribution to air pollution depending on their mobility are shown in Fig. 1

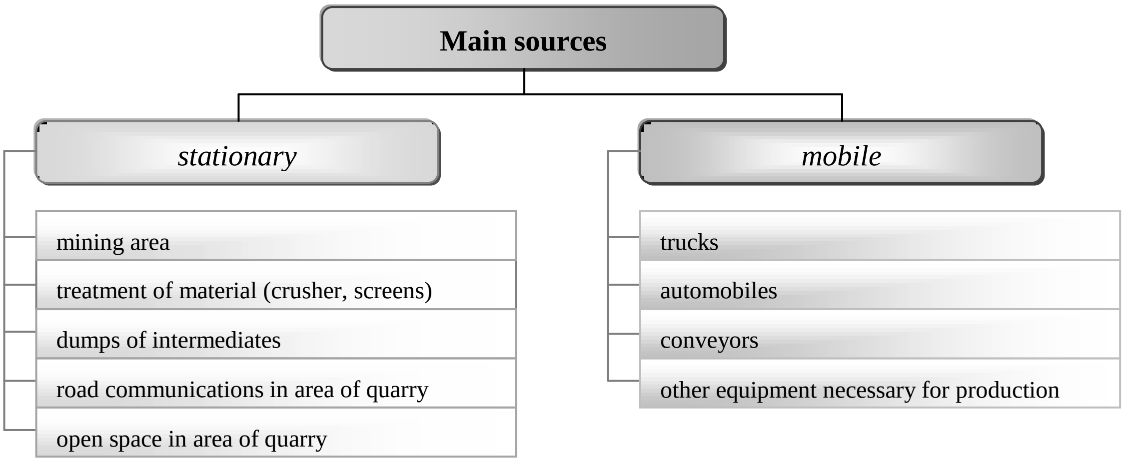

Figure 1: Sources of air pollution

In the site of the quarry and its surroundings there were made 6 stationary sampling of particulate matters. All samplings were performed during standard operation. Location of sampling points is shown in Fig. 2

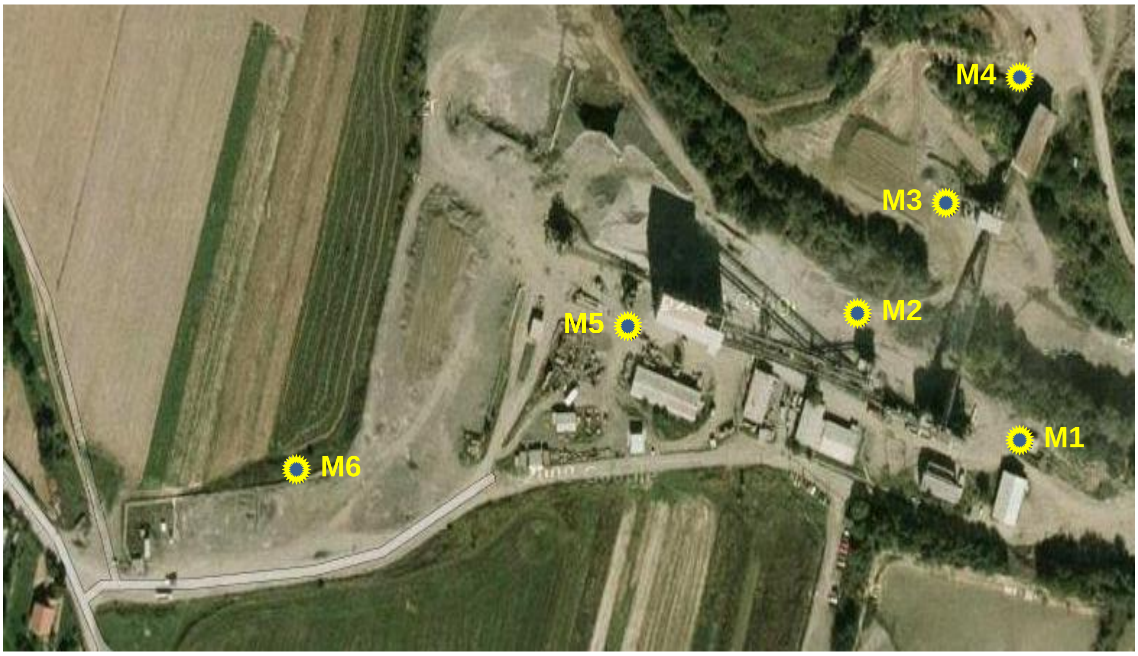

Figure 2: Location of sampling points

Sampling points were selected in consultation with the safety engineer, leader and also based on the meteorological conditions (wind rose). Sampling points M1 to M5 were located in the area of site and sampling point M6 was located on the boundary at the point closest to populated areas.

MEASUREMENT AND RESULTS

The measurement was realized with sampling equipment which was oriented in the direction to source of particulate matters. Length of sampling was 120 minutes. Measurement was realized at 2 m above ground level. During all sampling were recorded meteorological conditions.
From the obtained results were processed mathematical model pollution situations (Fig. 3). An important parameter in the projection of immission map is the landscape of the assessed area and in this case there is area with a maximum elevation of 2 m.

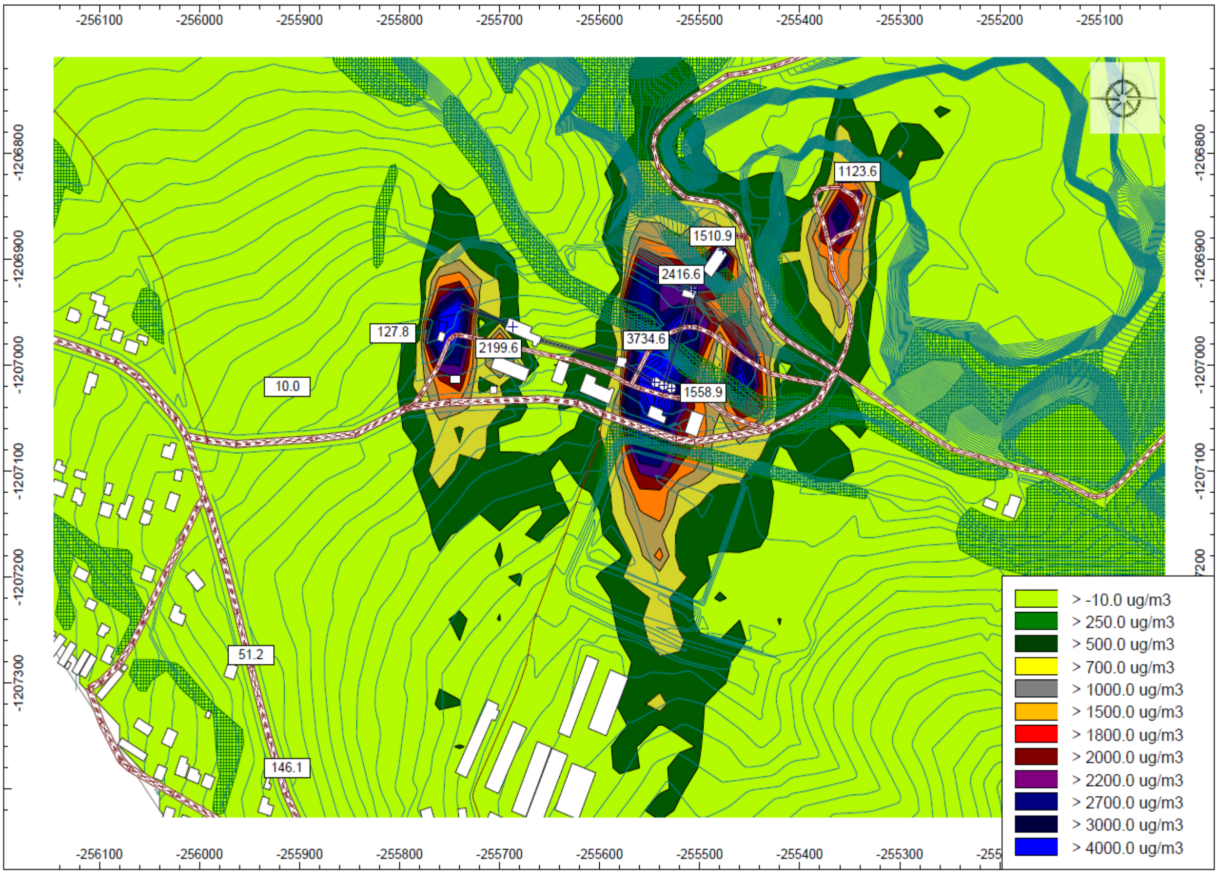

Figure 3: Mathematical model of immission map

Measurement was supplemented with the impact of traffic. The traffic is a source of emissions and also the secondary dustiness. Mathematical model of immission map for traffic is shown in Fig. 4. It follows that the traffic does not affect to people who live in the village near quarry.

Figure 4: Mathematical model of immission map – traffic

Immission maps, respectively model of pollution situation is created using Cadna/A 3.6.117 with embedded module for calculating the dispersion of pollutants in the atmosphere APL. This software Cadnam-APL allows calculation and evaluation of the spread of air pollutants (including particulate matters) that meet the requirements of the European Directive 1999/30/EC and 2000/69/EG.

CONCLUSION

Considering the amount of particulate matters generated by the site of quarry and also considering the distance from the village was created mathematical model of immission map. For these models, it is clear that the quarry does not affect to people who live in the village near quarry. Distribution of particulate matters in this case is strongly influenced by the terrain and the prevailing direction of air flow.
In the case that the situation has changed and particulate matters would spread towards the village, it is possible to apply some kind of measure. Methods for elimination of particulate matters in the mining of building stone may be:

- during the mining materials - the morphological shape of the area, respect interval between the blasting works and further operating with materials for adequate ventilation, another option is to choose a direction for future mining sections, replacing blasting at the secondary disconnecting hydraulic impactor, underground mining,

- during editing operations:
  - extraction (primary and secondary),
  - trickling material (tertiary),
  - fogging equipment (whole space technology),
- during transporting materials (roads in the quarry) - treatment of technological communication and periodic trickling road with tanks.

The complex solution is to change the whole technology, but it is a costly solution and does not guarantee a dust-free operation.

An appropriate solution to eliminate the distribution of particulate matters in the environment is a liner planting trees at the southwestern part of the quarry (to create a biological barrier). This solution is not ideal for this quarry, because it is not significantly affect the nearby village.

Due to the prevailing wind directions in the area of the quarry the overall cleanliness of the air near quarry is good.

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VERTICAL CAVES OBSERVATION PATH OF ALSÓHEGY (AN EFFECTIVE FIELD PRACTICE FOR ENVIRONMENTAL ENGINEERING STUDENTS IN AGGTELEKI NATIONAL PARK)

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Abstract: *The education of the environmental engineers (B.Sc.) includes a high quality theoretical knowledge, practical skills and ecological approaches. The appropriate practical skills are acquired by field trainings. These activities offer good opportunity for team works, right behaviour patterns, data treatments and improving the communication skills among real conditions. The field trainings are also useful to join together the theoretical knowledge of different courses and to apply them in a systematic way. The facilities of national parks fulfill every requirement of a good field practice. Their undisturbed conditions, protected flora and fauna, unique natural phenomena offer excellent observations, measurements and evaluations. They also show good references for environmental assessments. Field training on observation path of vertical caves of Alsó-hegy (Aggtelek National Park) is a good example for that.*

Keywords: *Observation path, caves, karst features, education of B.Sc. students*

INTRODUCTION

The education of the environmental engineers (B.Sc.) includes a high quality theoretical knowledge, practical skills and ecological approaches. The appropriate practical skills are acquired by field trainings. These activities offer good opportunity to learn team works, right behaviour patterns, data treatments and improving the communication skills among real conditions *(Kárász 2009)*. The field trainings are also useful to join together the theoretical knowledge of different courses and to apply them in real conditions *(Némethné 2006)*. The field practices also improve the right research methodology of students: observation evaluations and conclusions *(Kováts-Németh 2010)*.
The facilities of national parks fulfill every requirement of a good field practice. Their undisturbed conditions, protected flora and fauna, unique natural phenomena offer excellent observations, measurements and evaluations. They also show good references for environmental assessments. Aggteleki Nemzeti Park (ANP, Aggtelek National Park) was

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chosen for summer field practices of environmental engineering students (B.Sc.) in recent years. ANP is our first national park, which was established in 1985. Very high density of vertical and horizontal caves, nice cultural heritage of the region, archeological finds were the reason, why the ANP has become members of UNESCO Word Heritage network in 1995.
Alsó-hegy was chosen for a study trip in our summer practice. Alsó-hegy is an excellent terrain to learn the karstic phenomena for our students in ANP. Eight big caves (Almási-zsomboly, Frank-barlang, Kopaszgaly-oldali 2. sz. víznyelőbarlang, Kopasz-vigasz-barlang, Meteor-barlang, Szabó-pallagi-zsomboly, Széki-zsomboly, Vecsembükki-zsomboly) locate here from the 25 highly protected caves of ANP. An observation path has been marked out with 14 stations and its guide book has been published with the title: Alsóhegyi Zsombolyos Tanösvény (Observation path of vertical caves of Alsó-hegy) by Krisztián Koleszár. The booklet directs along the path and contains explaining texts, pictures, surface and cave maps. This observation path shows not only several vertical caves but it also presents karren fields, dints, dolines, sink holes, canyons and springs in surface. The observation path calls way several entrances of vertical and horizontal caves. The guide book of observation path contains the maps of the main caves. There are several explanations which are dealing with general aspects and local specialties of the cave genesis. It contains not only karstic phenomena, but it draws attention for other natural objects (e.g. tuff scatterings, meteorological phenomena, and rare species of vegetation) and cultural heritages (e.g. churches, cemeteries and castles). This paper presents our field practice which based on Alsó-hegyi Zsombolyos Tanösvény booklet. Our field trip however was tuned up with facts and experiments to suit better to our education system of environmental engineer students. This trip was designed for B.Sc. students, but its several parts are also appropriate for education of the high school students too.

AGGTELEK NATIONAL PARK (ANP)

The most part of 200 km^2 karstic region of Northern Hungary belongs to shallow see Wetterstein formation (Limestone). The rocks of this area are deposited approximately 220 million years ago in Mesozoic, Triassic period *(Nyerges et al 2006).* The recent formations are results of five million years genesis. This famous karst region is separated by Hungarian-Slovakian border. The Northern part of Gömör-Tornai karst region (Figure 1) belongs to Slovakia, which is also a protected area called Slovak Karst Nature Conservation Area.

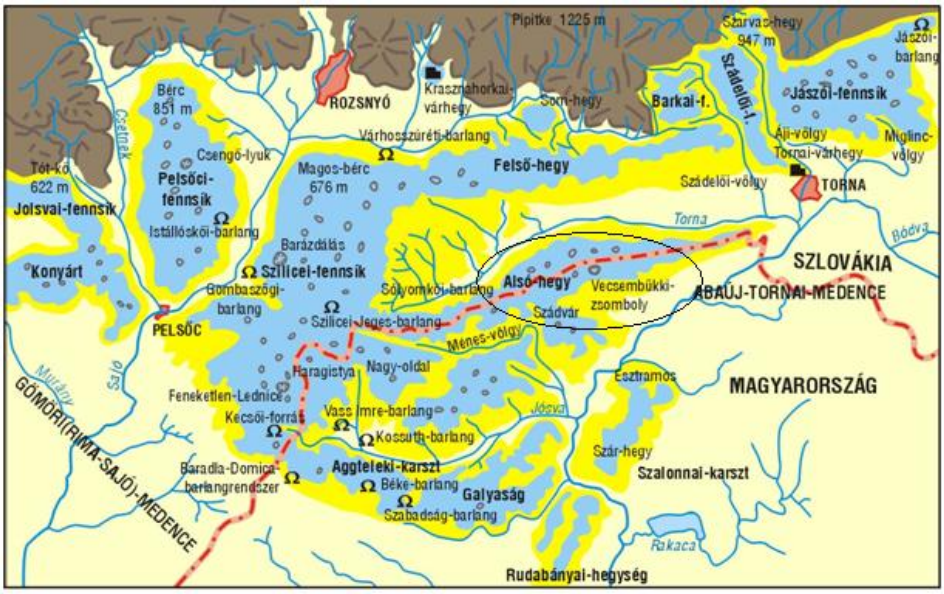

Figure 1. Map of Gömör-Tornai karst, Alsó-hegy is marked with circle *(Pannon Enciklopédia)*

Alsó-hegy is confined: south, Bódva river and Ménes creek; north, Torna creek; west, Szilice plateau. Its expansion is 50 km^2 with 400-500 m elevation *(Nyerges).*
The vegetation of this area shows high diversity, coming from the karst rocks and extreme microclimatic conditions. The typical tree species are the hornbeam and oak, but several other species occur. The glades among the woods have forest steppe characters *(Koleszár 2004-2005).* The typical trees of southern slops are oaks and junipers. The evidences of human influences are the meadows in the dry plateau. More than 1000 species butterfly and 1500 species bugs can be found here. The largest species of vertebrates are the birds with 127 species. The most famous species of birds is the highly protected imperial eagles *(Székely 2001)*. The most valuable species are the Pannon gyík (Ablepharus Kitaibelii Fitzingeri) from the lizards, and the heraldic animal of the ANP the spotted salamander (Salamandra Salamandra) from amphibians (Figure 2). The most characteristic karst formations are the 112 vertical caves, 64 are situated in Hungary *(Nyerges et al 2006).*

THE VERTICAL CAVE OBSERVATION PATH

The observation path is 8.5 km long, and rises 355 meter having 14 stations (Figure 3). The trailhead of the path is situated in the middle of Bódvaszilas village. A reference map helps the orientation in the trailhead.

Figure 2. The spotted salamander (Salamandra Salamandra) the heraldic animal of ANP *(Koleszár 16.10.2004.)* *(http://www.eszaktura.hu/szovetseguj/zsomboly.htm)*

Figure 3. The stations of „Zsombolyos tanösvény” vertical cave observation path

This part of paper presents the short description of observation path. The italic texts are the tasks of the students.

Kavacsos

The trip pathway by a classical manorial granary toward to Kavacsos. The Kavacsos's rock consists of Late Permian red sandstone and a well-cemented rock (conglomerate).

The students observed the gravels of Kavacsos. They describe the rocks according to the following: colour, hardness, stratification, measure of particles and their dispersion. They also studied the erosion channels on the bedrock.

The trail crosses hornbeam forest and later a planted spruce forest. The traces of lime kilns can be easily recognize.

The student recognized the differences between the dents of lime kilns and the cones of sinkholes.

Macskatemplom, Pályi kút

The path calls on the way Macskatemplom (Cat church), a big grey pink-foliated limestone slab (Hallstatt formation) (Figure 4) and the Pályi-kút (Pályi well).

Macskatemplom is appropriate for the observation of erosion phenomena. The cracks are created by water and vegetation. The dried up spring of Pályi-kút well demonstrates that new springs are come to existence from time to time. The deepening of the caves's bottom resulted in new springs in a lower level of the mountains than previous ones.

Figure 4. Macskatemplom (cat church) Hallstat limestone limestone *(Koleszár 26.10. 2004.)*

Figure 5. An abandoned mine *(Koleszár 23.04.2011.)*

"Márvány"-bánya (Marble mine)

There are several limestone mines for decorative purposes in the Gömör-Tornai mountain region. Two mossy hewn rocks sign an abandoned rock mine along the path (Figure 5).

The remaining rock slabs offer a good opportunity to show the structure of the hard limestone. The fresh fracture on the rock show gray calcite veins observing with a magnifying glass. Grey veins of calcite-crystals can be observed crossing each other and filling out the basically grey or pink angular patches on the rock (1-2 cm). The explanation of this texture is the following: The original limestone had broken for gravels (breccia), and the spaces among the gravels were filled by the precipitating calcite.

The trail crosses a young oak-hornbeam forest and a bushy terrain, then a field with dints (ördögszántás, devil plowing). The dints are the consequences of clearances and viticulture. Namely these activities have resulted in intensified soil and rock erosions.

This point is excellent to study the steps of karstic erosion. The niches and spherical holes were made corrosion of the humic acids, which were strengthened by human activities.

Bak Antal töbre, Tektonik-zsomboly (Bak Antals doline, Tektonik vertical cave)

The next station of this observation path is Bakk Antal töbör, a typical doline. The dolines are the most characteristic formations of karstic surfaces. The infiltrating water of rains and snowmelts solves the limestone easily, creating depressions. Generally they are circular, caldron shape depressions. The characteristic shapes of the dolines have 50-200meter diameters and 10-20 meter depths in this mountain.

The microclimatic differences can be study in this doline. The rim of doline has less dense vegetation, than the bottom of doline. Namely the soil is thicker in the bottom of doline and the bottom of it traps the humidity, and the runoff water. Moreover, the slopes of the doline show difference in their vegetation. The distinct orientated slops catch non-uniform quantity of sunshine.

The Tektonik-zsomboly (Figure 6) is the first vertical cave of the trail. Its entrance is a narrow fissure (Figure 7). The cave is 80 meter deep (the fourth deepest cave in Alsó-hegy) and 350 long. The Tektonik and other caves of Alsó-hegy can be visited only with guides, and a high quality alpine skill is required to descend into them.

Figure 6. Bakk Antal töbör with the entrance vertical fissure of Tektonik vertical cave *(www.barlang.hu)*.

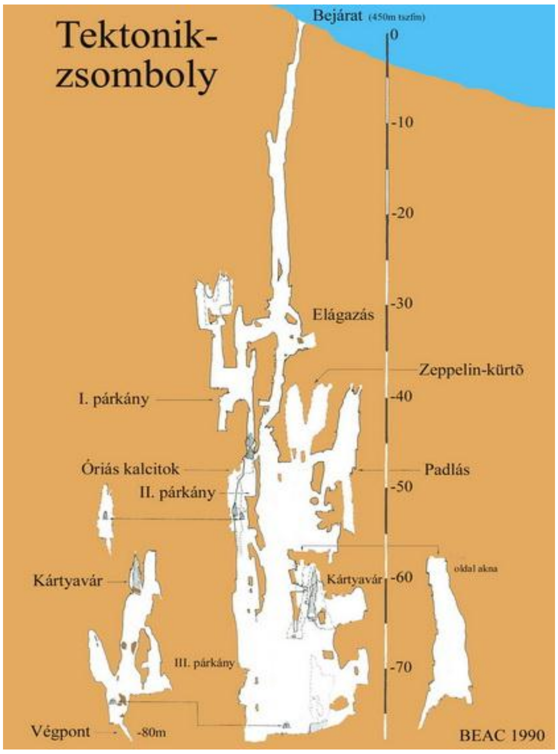

Figure 7. The segment map of the Tektonik cave *(www.barlang.hu).*

The developments of the pits of caves start independently from each others. The infiltrating water leaches the limestone along the vertical cracks. Further dissolutions of limestone result in bigger and bigger pitches and interconnections of caverns. During the enlargement processes, the remaining clay deposits at the bottom of pitches. The clay layer clogs the water flow; therefore the water flows down in the neighbouring pits. The roofs of caverns, nearest to the surface, collapse, because the rocks erode most intensively close to the surface (*Nyerges 2000).* Every vertical cave shows significant tectonic activity. They consist of vertical and parallel pitches. The vertical caves of Aggtelek karstic region were born in Pliocene age (*Kósa 1992).*

This entrance and the segment maps of the Tektonik represent well the vertical caves forms for students. The cave starts with a vertical pitch. The diameters of pitches become broader and broader downward. They are not sinkholes. Their entrances are in the upper third parts of dolines, because the bottom of dolines is clogged by debris and clay. They have no surface catchment's area.

After the Tektonic cave the trail leads above 500 meter elevation to Vecsembükk. This is the densest zone of vertical caves of Alsó-hegy. 21 vertical caves are located in half square kilometre area. *(Koleszár 2004-2005).*

Vecsembükki-zsomboly

The highly protected Vecsembükki-zsomboly is the deepest vertical cave (236 m) in Hungary (Figure 8, 9). Here is also the deepest pitch (83 m) of Hungary. Their pitches are close to each other. Only narrow walls separate the caverns. Bridges and ledges subdivide the pits. Rich flowstone layers cover the walls of the cave. Stalagmite and stalactite formations are in the upper part of the cave. The palm tree formations are habitual in the lover parts. The drops of the water fall down from big distances and they create aerosol which result in palm tree formations *(Kordos et al. 1984).*

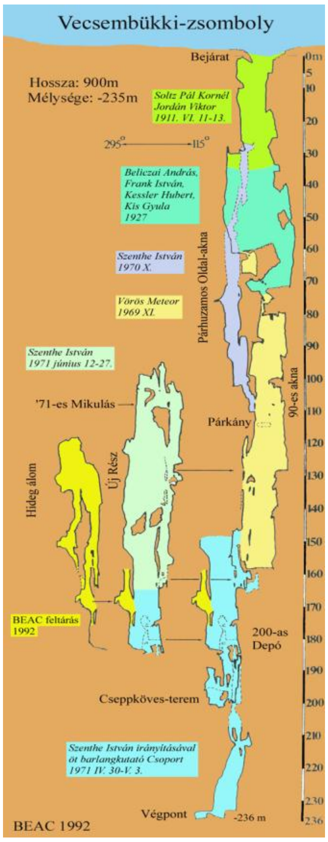

Figure 8. The segment map of Vecsembükki zsomboly *(www.barlang.hu)*

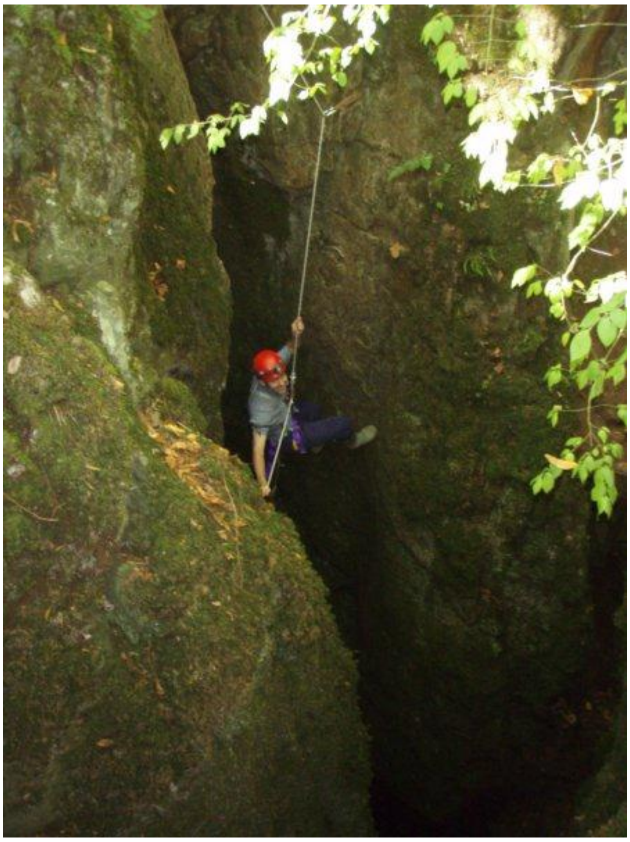

Figure 9. Descending to Vecsembükki zsomboly *(http://www.gubacs.hu/fotok)*

The attention of students is drawn to the vegetation. The Wetterstein formation of rock reaches the surface in rim of dolines. The soil layers are thin, therefore the trees are scrubby.

Nászút-barlang (Honey-moon cave)

Characteristic forms of plateau are the depressions. The ceilings of the caverns weakened by leaching and fall down. The debris consists of big rock units, which leave holes among them. Small animals occupy these holes. *(Koleszár 2004-2005).*

The students can recognize the small soil piles, which were scraped out by the resident animals.

From this point the trail descends.

Szabó-pallag and nearby vertical caves

Szabó-pallag is a big meadow (Figure 10). *The vegetation of this area is a typical middle dry mountain meadow. The booklet of the trip and our plant adverb help the students to determine the typical species.*

Figure 10. Szabó-pallag with a feeding for wilds *(Koleszár 2004-2005)*

Figure 11. The entrance of Baglyok szakadéka (Owl canyon) *(www.barlang.hu)*

Close to the path is 100 meter deep and 358 meter long Almási-zsomboly. Széky-zsomboly locates 120 m from the Almási-zsomboly. This cave is 50 meter deep having a scalar structure. Its wall is richly decorated with dripstones. The most interesting phenomena of this cave are the helictites the bent stalagmites. The Baglyok szakadéka (Owl canyon) (Figure 11) is 151 meter deep and has 850 horizontal expansions. Its name was given after the owls nestling in its first big pit.

Kis és a Nagy vizes töbör (Small and Big Watery doline)

The trail descends in the bottom of a small valley to the doline called Kis-Vizes töbör. The rocks of the Kis-Vizes-töbör belong to Hallstat formations (Hangandrotkalk).

The task is the comparison of the pink-red rocks of this doline and the previously seen rocks of the trip.

The entrance of Meteor cave is located in this doline, which was discovered in 1961. The Meteor cave is not a vertical cave, but it belongs to the typical karstic formations of Alsó-hegy. Its more than 120 long cavern, Titánok csarnoka (Hall of Titans) is the largest cavern of Hungary. There are huge colorful stalagmites and stalagmites. A lot of colourful straws, stalactite curtains, sinter pools and helictites are visible in very diverse forms.
Next station is a sinkhole, a typical formation of karstic surfaces in Nagy-Vizes-töbör (Big Watery Doline). The Pócsakői víznyelő (Pócsakői sinkhole), (Figure 12, 13) is a steep cone shaped depression with thick soil deposition and big rocks. A big hole, the entrance of Pócsakői víznyelőbarlang (Pócskői sinkhole cave) is at the bottom of the cone. This cave is a typical example the sinkhole originated caves.
It is 87 meter long and 51 meter deep *(http://www.termeszetvedelem.hu/index.php?pg=caves).*
The sinkholes are created by the leaching of the carbonate rocks. They have conical depressions with steep convex slopes. They have definite catchment area. The sinkholes swallow up the solved rocks and soil, and their growing processes transform the sinkholes to doline. The sinkholes frequently solve out caves at their bottom.
The water of these sinkholes and several caves comes to the surface in the Vecsem spring *(Székely 2003).*

Figure 12. Pócsakői sinkhole *(Bodáné 30.06.2011.)* Figure 13. Segment map of Pócsakői sinkhole cave *(www.barlang.hu)*

Szőlősfej-kerti-Barlangkutató-forrás (Vineyard or Caver spring)
The last station of observation path is the spring of Szilas creek, which is called Szőlősfej-kerti or Barlangkutató spring (Figure 14). It has 151 l/min average discharge.

Figure 14. Szőlősfej-kerti-Barlangkutató -forrás (Vineyard or Caver spring) *(Bodáné 30.06.2011.)*

Figure 15. Students and teachers on the field training *(Bodáné 30.06.2011.)*

The vicinity of spring is covered sandstone flakes. The spring is in the border of water permeable carbonate rock and watertight sandstone rocks. The student measured the discharge of the spring. The filling period of the known volume bucket was measured.

CHEMICAL TESTING OF SPRING OF ALSÓ-HEGY

The summer practice includes some chemical analysis of springs and creeks. The 2-3 member groups of students looked up the spring of Hungarian part of Alsó-hegy (Figure 16). The springs were looked up by GPS and they were sampled. The results of chemical analyses are summarized in Table I.

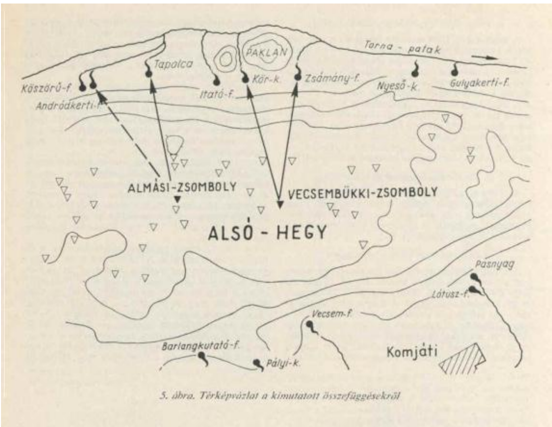

Figure 16. The springs of Alsó-hegy.

The arrows show the connections among some vertical caves and their spring in the foothill
(http://www.barlang.hu/pages/alsohegy/tartalom.htm)

Figure 17. Water analysis by students *(Bodáné 01.07.2011)*

Table 1. The results of chemical analysis of springs at the foothill of Alsó-hegy *(Takács 2009)*

Tested parameters	**Name of the springs**				
	Vecsem	**Kastélykert**	**Serház- kút**	**Pasnyag**	**Rongyos kút**
NO_3-N [mg/l]	1.8	3.6	3.9	<0.5	2.8
p-alkalinity [mmol/dm^3]	0	0	0	0	0
m- alkalinity [mmol/dm^3]	2.3	1.9	1,6	1.7	1.5
pH	7.3	7.5	7.7	7.5	7.5
Conductivity[µS/cm]	590	570	510	540	510
Ca [mg/l]	143	128	96	121	102
Mg [mg/l]	24.9	20	35.9	8	28.6

The data suggest the following: Nitrate contents of springs are low, in spite of active rock mine is in the Slovakian part of Alsó-hegy. The water of the area of mine comes up to the surface in Slovakian part of Alsó-hegy. No phenolphthalein alkalinity was found in the tested springs. The water of the springs has low magnesium content, which suggest of absent of dolomite rocks. The final conclusion is the tested springs produce potable water according to the tested parameters.

SUMMARY

The presented field practice illustrates our objective in environmental engineering education to train students for considering environment protection besides finding technological solutions. The study trip on the vertical cave observation path is excellent to link the theoretical knowledge of various lectures and apply them to real life conditions. This education method is convenient for students to recognize complexity of phenomena and cause effect relations. This method of field training education – beyond professional training – gives opportunity to establish environment and nature saving behaviour based on fondness and respect of nature.

Acknowledgment
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ENERGY SAVING EFFICIENT LIGHTING SYSTEMS

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Abstract: *Paper describes new trends of use environmental friendly lighting sources and measures for progressive efficient lighting systems application. This contribution under the theme of energy-saving lighting systems is cover the development of energy saving, highly efficient lighting fixtures, and the trends of the most advanced technologies for efficient lighting, which are applicable at present.*

Keywords: *Illumination, energy saving, working environment, lighting sources.*

INTRODUCTION

Light is one of the factors for creation of the contentment. By investing in innovations improving the working environment, including lighting, the conditions for improving work performance are being created, thereby increasing the return of the invested funds. With the constant upgrading and improvement of working practices comes an increase of the requirements for creating and editing work environment, which consists of a set of tangible and intangible external factors directly affecting the employee and his/her work. Creation of a favorable working environment is a complex process, in which an important thing is the fact that the working man spends in this environment eight hours a day. Progressive lighting systems are using next-generation light sources that are environmentally managing, reliable, they are long-lasting, energy-saving, and so it is possible to achieve financial savings in lighting work areas up to 60%. Selections of light sources are based on the basic requirements for lighting of the different operation. These requests are accepted in particular with an adequate intensity of lighting, appropriate brightness, contrast of brightness, and the color and in the right direction of light incidence and the like. While fulfilling all quantitative and qualitative parameters of the lighting intensity during the design of a lighting system we must consider the principles of maximum efficiency. Assessing the energy efficiency of lighting makes sense only if the lighting and lighting parameters in the area correspond to its purpose and use.

ENERGY CONSUMPTION FOR LIGHTING

Lighting conditions in industrial operations are currently at a level, which in many cases does not satisfy the requirements set out by legislation and standards. Slovakia has highly energy-intensive industrial structure, where dominates the engineering industry. The proportion of electricity attributable to theartificial lighting is significant and not negligible.

Installation and operation of energy efficient lighting systems is in most cases not yet considered a major priority, because the available funds are primarily used for the operation, modernization of production process, and other related activities, that are directly related to the production, and the existence of industrial enterprises andinstitutions.

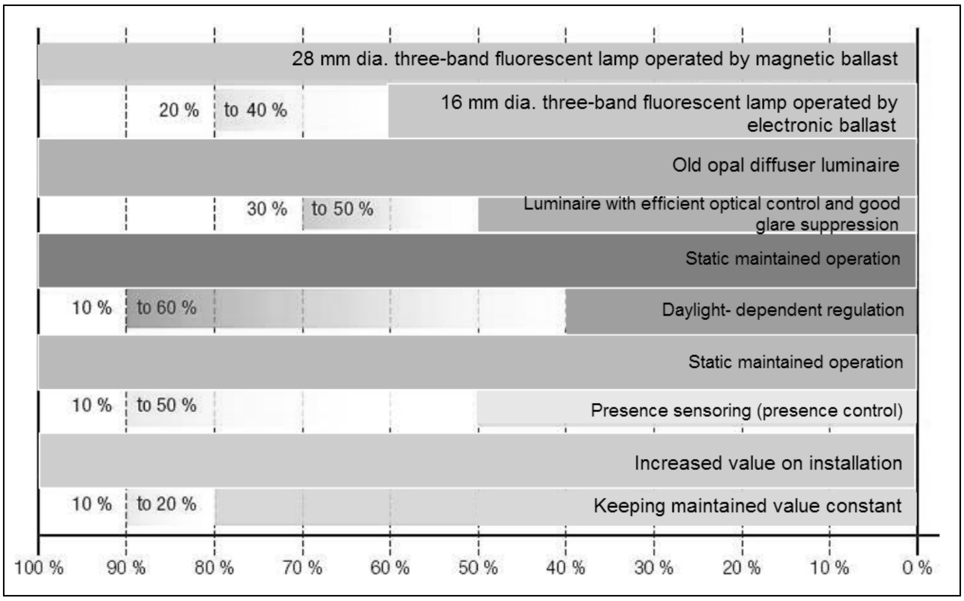
Light sources and their operation significantly affect the efficiency of lighting, so with the designing of new lighting systems or with the reconstruction and modernization, an increased attention must be payed in their selection. Saving electricity is not only the result of pressure of the users to reduce their costs, but also becomes an obligation in accordance with policy of energy efficiency, defined in existing and newly prepared EU legislation [1].
In the design phase, the evidence of lighting parameters are the protocols of a lighting calculations. In the already implemented buildings, the evidence are a protocols of the measurement of the lighting parameters [2]. Particularly in the energy audits can be seen, that energy savings when illuminating, are usually most obvious and easiest to achieve.
Approaches to considerations about lighting energy consumption varies, depending on whether the proposed, possibly newly implemented object, or if the energy consumption of existing building is assessed. For the choice of strategy to draft the energy saving measures, it is possible to proceed from the fundamental relationexpressing energy consumption for lighting, in a period of time, for example:

$$W = P_p \times t_o \qquad [\mathrm{kWh.\ year^{-1}}] \qquad (1)$$

Where:

P_p - is average operational wattage of lights [kW],
t_o - is operational time [h.year^{-1}].

From the relation listed above, it is clear, that the strategy in searching for savings in electricity consumption for lighting, can be based on finding savings in operating wattage, or in times when using lighting system, eventually. On a combination of both parameters. Strategies, on which may be based the saving measures are shown on Figure.



Fiure.1 Possibilities to achieve financial savings on illumination

Lighting system for artificial lighting is a system of technical devices, consisting of lights, light sources, ballasts, control systems and accessories, which is primarily intended to create the desired light environment. Lighting systems can be distinguished according to their type, and according to their nature. The type and nature of the lighting system alike impact their energy consumption [3].

INOVATIVE LIGHTING TECHNOLOGIES

Progressive and inovative lighting systems are using next-generation light sources that are environmentally managing, reliable, they are long-lasting, energy-saving, and so it is possible to achieve financial savings in lighting work areas up to 60%. Selection of light source, (see Table 1) is based on the basic requirements for lighting of the industrial operation. These requests are accepted in particular with an adequate intensity of lighting, appropriate brightness, contrast of brightness, and the colour and in the right direction of light incidence and the like. While fulfilling all quantitative and qualitative parameters of the lighting intensity during the design of a lighting system we must consider the principles of maximum efficiency. Assessing the energy efficiency of lighting makes sense only if the lighting and lighting parameters in the area correspond to its purpose and use.

Table 1 Comparison of LED with existing lighting technologies

	LED	Incendes-cend	Halogen	Compact fluorescent	Fluorescent	Metal halide	Hight pre-ssure sodium
Typ lumen output [lm.W^{-1}]	*Real** 94	10	20	50	75	80	120
Converter efficiency [%]	80-90	100	100	80-90	80-90	80-90	80-90
Luminiare efficiency [%]	80-90	30-50	30-50	50-60	50-70	40-80	40-80
System efficiency [lm.W^{-1}]	**60-73**	**4**	**8**	**23**	**38**	**41**	**61**
Life time [h]	>50 000	1000	3000	10000	15000	10000	16000

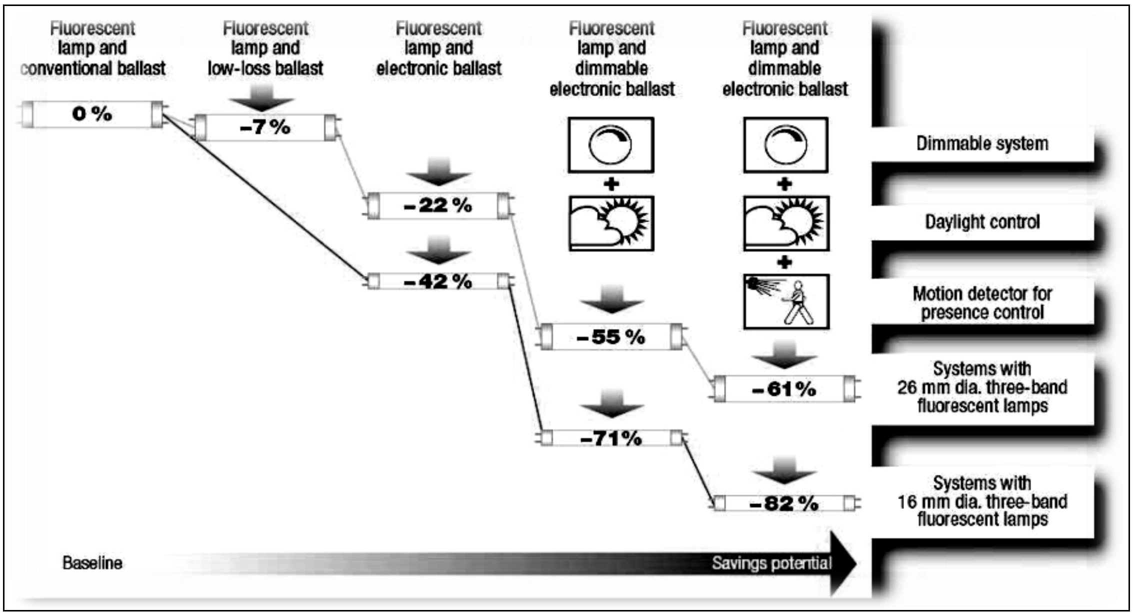
*) By using a LED (Cree XP-G) with min. 114 lm with typically 1,05 W (3,0V x 0,35A) power consumption and at “normal” (Tj = 80°C) operating conditions: 114 lm x 0,87 / 1,05W = 94 lm/W

Despite the reported examples, however, the best savings are achieved by combining artificial and natural light. Lighting during the day leads to high costs. That is why the lighting control in industry increasingly interests the operators. This is mainly meant for production facilities, storage facilities and associated offices. In these areas it is necessary to ensure the regulation of a constant light intensity and also with consideration of daylight, for example transoms and light guides [4]. These lighting control systems are based on:

– monitoring the presence,
– scheduling,
– dimming control, depending on the intensity of daylight,
– management of constant light levels.

Dimming of the light source is the best known and most basic form of lighting control. Options of how to creatively manage lighting are multiplying, as well as the ways of influencing the nature of light, with a purpose to create an ideal atmosphere for any activity, for example changing the temperature chromaticity, mixing the colors of light or a dynamic copying of a daylight.
With a implementation of a computer intelligence, environmental and economic aspects it is possible to optimize parameters of lighting systems and achieve energy savings, ranging from 30% up to 80%. By adapting the intensity of illumination in indoor environments, it is possible to evolve solutions, depending on the variability of daylight, the movement of people in the area as much as a time scheduling. An example of a simple and automatic control of

lighting is the system DALI (Digital Addressable Lighting Interface - Digital addressable lightinginterface), which can be easily integrated into a comprehensive system of building management.
In conjunction with the visualization software it is possible to monitor, adjust and control the entire system by the central unit, for example touch panel or PC, and also monitor the operating hours of each lighting device and display their service life, allowing more effective planning of the maintenance of the entire lighting system and reduce energy consumption for lighting up to 80% (Figure 2). [5]



Fiure.3 Reducing of energy consumption for lighting

RESULTS

As an example of innovation and optimization of illumination, can be presented a lighting renovation project of operation of the unnamed factory, in which the medium mounting work is carried out, where the requirement of illuminance is 300 lx, color submission (Ra) min. 80 and the flare index UGRL max. 25, and in which was implemented an exchange of a gas-discharge lighting with luminaires with fluorescent lamps. The original lighting system with halide lamps (900 units) was below the required illuminance values. The parameters of light sources are in Table 2.

Table 2 – Paramters of lighting source

Lighting source	Wattage	Specific wattage	Index of color submission (Ra)	Lumen depression during lifetime
Halide lamp with phosphor	400 W	71 lm. W^{-1}	Ra > 90	30% per 12 000 h
Fluorescent lamp	54 W	85 lm. W^{-1}	Ra > 80	10% per 24 000 h

Thanks to this innovative project of rationalization of lighting system in the operation of the process plant, where the greatest energy savings and the associated financial savings were achieved, mainly the implementation of smart lighting control systemlighting power consumption was reduced by 40%. In addition, the investor saved additional costs for a implementation of an additional illuminator for places, that did not meet operational standards with the previous gas-discharge lamps.

CONCLUSION

According to the main objectives of the European countries to reduce energy consumption in all the areas of its use, it is necessary to seek new solutions of the economical use of energy resources in the area of lighting. The requirements of current users of lighting systems grow as fast as consumption and price of electricity as a result of which we meet more frequently with the concept of management and control of lighting and it can be assumed, that in this exact area of lighting rationalization will be oriented its research and development.

Acknowledgment

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EVALUATION OF VOLATILE ORGANIC COMPONENTS OF INDOOR AIR OF A NEWLY-BUILT WOODEN FRAME HOUSE IN THE LAST FOUR SEASONS

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Abstract: *Over recent decades, there have been many changes in the way buildings are constructed and operated. Improved insulation and advances in construction technology have led to a much greater use of synthetic building materials. All these changes have undoubtedly meant that buildings are more comfortable. However, they have also provided an environment in which airborne contaminants are readily produced and may build up to substantially higher concentrations than are typically encountered outside. These harmful substances include volatile organic compounds (VOCs).*
This study aims to present the changes of VOC concentrations measured in the indoor air of a low-energy, framehouse in the heating season and during summer. The residents did not move in the house after the completion of the construction, only experimental measurements were conducted. There were six measurements conducted, four samples were taken in the heating season, and two samples during summer time. The main VOC materials which concentrations were significant in all measurements were terpenes (limonene, alpha-pinene, 3-carene), aliphatic-hydrocarbons and aldehydes (acetic acid, 2-Methoxy-1-ethylmethyl acetate).
The conditions during the measurements significantly influenced the concentration of certain values (e.g.:3-carene, alpha-pinene). Their main source could be wood-based building materials. The increase in indoor air temperature may cause the increase in concentrations. None of the concentrations of the tested substances reached the extent of adverse health effects.

Keywords: *indoor air quality, VOC, framehouse, wood-based building materials*

1. INTRODUCTION

The global climate change and increasing energy requirements have led to the development of airtight, energy-saving buildings with very low air exchange rates. Because of the cheap mass-production the most common building materials are synthetic materials. The houses may become more and more comfortable and automatized, still the question arises: Do these technical improvements provide a healthy living-space for people?
Indoor air quality (IAQ) has presented a growing concern since the 1950s [12]. The IAQ deterioration is due to the occurrence in the indoor air of a large number of chemicals, or classes of chemicals. Major sources are human activities, building product emissions, and infiltration of the outdoor air [1]. Among the most important categories of indoor chemicals are volatile organic compounds (VOCs) and carbonyls. VOCs as a group have been defined with boiling points from about 50°C to about 260°C [2]. They are ubiquitous indoors. In renovated or completely new buildings, the VOCs concentration levels are often higher detected. The primary emission of VOCs (e.g., solvents) from building products generally dominates for a period of up to six months. Ageing of building products, by chemical (e.g., ozone, maintenance, moisture) or physical (e.g., heat, weariness, UV-light) decomposition may result in secondary emissions, which contribute to the pollution indoors, in some cases

continuously [3]. The most commonly found VOCs are BTXS (benzene, toluene, xylenes and styrene) and terpenes (α-pinene, limonene, etc.); major indoor carbonyl compounds include formaldehyde and acetaldehyde. The reasons for the broad occurrence of these chemicals are their volatile character and the fact, that they have been used widely in a big number of household products like paints, varnishes, waxes, solvents, detergents, or cleaning products (Table 1) [4] [5]. Many studies have demonstrated that building materials can be significant emission sources of Volatile Organic Compounds (VOCs), which may affect and determine the concentration levels in indoor environments [6]. It was concluded that VOCs such as benzene, formaldehyde, acetaldehyde, toluene and xylenes have to be considered as priority pollutants with respect to their health effects [7]. Although, numerous studies have investigated the levels of indoor air pollutants and emission measurements in laboratories, research on systematic in- field studies, linking the VOC concentrations to their indoor sources is rather limited [8].

Table1: Sources of common volatile organic compounds in indoor air [11]

Sources	Examples of typical contaminants	
Building materials	aliphatic hydrocarbons	*n*-decane, *n*-dodecane
	aromatic hydrocarbons	toluene, styrene, ethylbenzene
	halogenated hydrocarbons	vinyl-chloride
	aldehydes	formaldehyde
	ketones	acetone, butanone
	esters	urethane, ethylacetate
	ethers	
Combustion appliances	aliphatic hydrocarbons	propane, butane, isobutane
	aldehydes	acetaldehyde, acrolein
Paints and associated supplies	aliphatic hydrocarbons	n-hexane, n-heptane
	aromatic hydrocarbons	toluene
	halogenated hydrocarbons	methylene chloride, propylene dichloride
	alcohols	
	ketones	methyl ethyl ketone
	esters	ethyl acetate
	ethers	methyl ether, ethyle ether, butyl ether
Adhesives	aliphatic hydrocarbons	hexane, heptane
	aromatic hydrocarbons	
	halogenated hydrocarbons	
	alcohols	
	amines	
	ketones	acetone, methyl ethyl ketone
	esters	vinyl acetate
	ethers	
Furnishings and clothing	aromatic hydrocarbons	styrene, brominated aromatics
	halogenated hydrocarbons	vinyl chloride
	aldehydes	formaldehyde
	esters	
	ethers	
Consumer and commercial products	aliphatic hydrocarbons	n-decane, branched alkanes
	aromatic hydrocarbons	toluene, xylenes
	halogenated hydrocarbons	methylene chloride
	alcohols, ketones	acetone, methyl ethyl ketone
	aldehydes	formaldehyde
	esters	alkyl ethoxylate
	ethers	glycol ethers
	terpenes	limonene, alpha-pinene

Because of the differences in factors such as climatic conditions, lifestyles, and construction habits the indoor environments can vary from region to region, and country to country. However, despite this variation, many industrialised societies are facing a growing number of very similar indoor air quality problems. It is necessary to re-evaluate the way in which buildings are designed and constructed. There must be a change in the way of how architects and builders are thinking. They need to have the proper information and database of ecological materials and technologies, to create with breathing structures an environmentally-conscious, healthy living-space.
The aim of this study is to present the changes of VOC concentrations measured in the indoor air of a low-energy, framehouse in the heating season and during summer.

2. CASE STUDIES FROM LITERATURE

In the study [9] the effects of seasons on indoor-VOCs were investigated on the basis of 2103 measurements in different cities of Germany with monthly repeated measurements of VOCs in 10 selected apartments. 30 VOCs were selected from a variety of substances that can be detected in the indoor air. They belong to the following groups: alkanes, cycloalkanes, aromatic compounds, halogenated hydrocarbons and terpenes. The results provide strong evidence of a clear seasonal variation. Maximum median values for a month in winter were on average two times as high as the lowest median values for a month in summer. The air exchange rate is the predominant reason for temporal variations in indoor air quality. Another cause for the seasonal pattern of indoor-VOC concentrations might be a seasonal variation in indoor temperature and/or humidity that may effect the concentrations of indoor sources. The conclusion is that a general set of factors for seasonal adjustment is not recommendable. In order to get a full picture of the subtle effects of the indoor sources further researches will be necessary. In a Finnish study [10] there were several measurements conducted in new residential buildings. After 6 and 12 months the temperature, relative humidity, air exchange rate and the VOCs concentrations were determined. The results showed that the TVOC concentrations generally varied between 300 and 1300 μgm^{-3} in the newly finished buildings. Totally, 72 different VOCs occurring at least in four apartments were identified. The xylenes, with a mean concentration 160 μgm^{-3} were the dominating VOCs in the newly finished buildings. Alpha - pinene, with a mean concentration level of 64 μgm^{-3} was the next. The TVOC concentration decreased below the level 600 μgm^{-3} in 6 months in all the apartments. No significant change was seen between the 6- and 12-month results. Seasonal changes effected for the indoor air RH: in winter time 15%, in summer 70%. The study showed that the VOCs concentrations are high in the newly finished apartments despite of selection of low-emitting materials and considering the building moisture. In the frame of BUMA (Prioritization of Building Materials Emissions as indoor pollution sources), a European funded project was conducted in five cities. There were done weekly measurements of the indoor air quality during summer and winter. The concentrations of the following materials were the highest: toluene (163.5μgm^{-3}), m,p-xylenes (177.4 μgm^{-3}), d-limonene (159.4 μgm^{-3}), acetone (308.8 μgm^{-3}) and hexanaldehyde (113.3 μgm^{-3}). The levels of formaldehyde remained below the WHO guideline of 100 μgm^{-3}. Benzene concentrations were lower than the average annual limit of 5 μgm^{-3}. It was concluded, that winter indoor concentrations are, in general, higher than in summer period. It was assumed that the sources of the significant concentrations of formaldehyde, acetaldehyde, acetone and limonene are the building materials. Although in the course of time these concentrations of VOCS are likely to reduce [18].

Table 2: The mean concentration of some VOCs in the 0-, 6- and 12-month-old buildings

Compounds	Indoor air concentration (μgm-3)		
	0 month	6 months	12 months
Benzene	not detected		
Ethyl benzene	42	3	6
1,3-Xilol és 1,4-Xilol	64	7	6
Styrene	4	3	5
3-Carene	26	30	35
alpha-pinene	88	59	61
beta-Pinene (b)	16	5	5
Limonene	26	16	25
Hexanal	33	15	16
Benzaldehyde	7	7	4
2-Methoxy-1-ethylmethyl acetate	not detected	5	6
Acetic acid	5	not detected	13

3. THE METHODOLOGY OF MEASUREMENTS

The sampling was performed in a newly built, low-energy, frame-house. The turnkey construction of the building was completed in the summer of 2012. It has an area of 120m^2, a ground floor and an attic room. Downstairs there are a hall, a living room + a kitchen, a room and a bathroom. From the living room there is a staircase leading up to the gallery, which opens into a room in the attic. The structure of the building consists of wooden frames and wooden panels with Isocell insulation, which is rendered from the outside and covered with gypsum fibre panels inside (Table 1). The interior walls are covered with solid wood panels. The house is heated with circulating hot air combined with an airing system. The heat is derived from solar panels and stored in seasonal thermal storage system. In addition, the ground floor heating is supported by electric under-floor heating in winter. The parameters of the rooms included in the sampling are given in Table 2.

Table 3: Outside wall layers (outside to inside)

No.	Thickness		Description	Thermal conductivity W/mK
1	5	mm	Breathable render	0.6
2	60	mm	Fiber Insulation Panel THD NF 230	0.05
			KVH 60x160 mm spruce, truss frame	0.1
3	160	mm	with 160 mm ISOCELL in between	0.039
4	12	mm	MFP	0.13
			KVH 60x160 mm spruce, truss frame	0.1
5	160	mm	with 160 mm ISOCELL in between	0.039
6	15	mm	H15 gypsum fibre board	0.22
7	0.25	mm	ÖKO-NATUR vapour-stop paper	
8	30	mm	Planed and dried spruce, batten framework	-
9	05.dec	mm	impregnated plasterboard	0.24

Table 4: Parameters of the rooms

Room	Structure	Cover	Area		Comment
1 Living room	Floor	Stone	25.ápr	m^2	unfurnished
	Wall	Gypsum fibre/Wood	50.0/30.0	m^2	
	Ceiling	Wood	máj.48	m^2	
2 Room	Floor	Stone	12.0	m^2	unfurnished
	Wall	Gypsum fibre/Wood	17.0/16.0	m^2	
	Ceiling	Cement rendering	12	m^2	
3 Bathroom	Floor	Stone	04.máj	m^2	unfurnished
	Wall	Wood	24.jan	m^2	
	Ceiling	Cement rendering	04.máj	m^2	

Sampling was performed in the building described in Section 4.1 and the samples were analysed by the laboratory of Wessling Hungary Ltd. An active sampling device was used on the site. During the sampling, in order to facilitate the accuracy of the laboratory tests the physical characteristics of indoor air had been set 24 hours before the sampling. Thus the sampling was performed in a stationary state.
The air exchange rate was 2.5 1/h, which means that during the measurement the doors and windows were closed [51].
Two sampling tubes were connected to the active measuring device used in the sampling. The sampling tube was a 200 mg Tenax TA stainless steel tube, 90 mm long, for sampling the VOCs.

Suction duration: 60 min
Suction rate: 100 ml/min
Suctioned air volume: 6000 ml

4. EVALUATION OF MEASUREMENT RESULTS

When we determined the VOC content of the samples taken from the indoor air we measured the concentrations of 180 components according to standards ISO 16000-6:2004. In Table 5 we included the measured concentrations of those VOC components out of the 180 measurement results whose values were significantly greater than the detection limit and are present in each room. Presumably, these are the materials which determine the quality of indoor air in the building.

Table 5: Measured concentrations of VOCs above detection limit

	1. Measurement	2. Measurement			3. Measurement			4. Measurement			5. Measurement			6. Measurement		
Time	2012.12.10	2013.01.17			2013.02.14			2013.03.07			2013.06.10			2013.07.15		
Temperature	**18**	**18**			**15**			**21**			**24**			**26**		
Relative Humidity	**41**	**37**			**37**			**40**			**43**			**43**		
Compound name	**Indoor**	**1. Living room**	**2. Room**	**3. Attic**	**1. Living room**	**2. Room**	**3. Attic**	**1. Living room**	**2. Room**	**3.Bathroom**	**1. Living room**	**2. Room**	**3.Bathroom**	**1. Living room**	**2. Attic**	**3.Bathroom**
Benzene	3,11	2,79	2	2,16	0,01	0,01	0,01	0,01	1,66	0,01	1,71	1,8	2,35	0,01	1,65	0,01
Toluene	11,6	4,92	4,78	5,09	5,16	4,74	6,13	4,97	6,85	19,7	34,4	37,1	38,4	4,86	3,36	6,21
Ethyl benzene	4,8	1,96	1,81	1,86	1,66	1,27	1,46	4,14	4,38	33	102	61,6	66,5	6,64	5,09	3,22
1,3-Xilol és 1,4-Xilol	20,8	8,59	7,57	8,23	6,72	5,36	5,31	11,6	12,5	104	76,8	90,5	96,8	7,09	5,14	4,19
Styrene	3,06	0,96	1,2	1,32	0,01	0,01	0,01	3,52	4,98	0,01	134	147	127	7,93	6,27	4,29
3-Carene	300	133	97,3	109	85,8	64,4	233	300	244	274	2120	468	1500	232	157	171
alpha-pinene	297	170	122	157	162	119	300	300	300	300	1130	1520	2710	284	211	217
beta-Pinene (b)	30	15,2	11,8	15,3	16,9	9,33	33,1	55,9	52,9	47,8	157	145	187	34,9	23,7	28,4
Limonene	64,7	21	16,1	17,5	15,8	10,7	23	59,7	51,9	46,3	178	118	289	30,2	21,9	25,1
Hexanal	48,9	23,8	19	21,3	16,4	9,88	20,7	79	57,8	65,9	199	218	244	57,1	42	66,9
Benzaldehyde	7,27	0,01	3,87	0,01	3,37	1,67	5,35	9,87	10,4	16,8	39,6	39,8	51,8	11,7	10,1	9,18
2-Methoxy-1-ethylmethyl acetate	28,8	17	14,3	14	24,5	15,3	12,8	110	123	78,2	112	141	120	24,9	15,7	16
Acetic acid	10,4	17,6	26,9	26,9	138	8,29	22,6	0,01	0,01	0,01	65,5	41,3	141	34,9	23,2	83,4

Measurement 1:

After the construction of the building was completed, the first measurement was taken before the heating was started. At this stage the inside doors had not been installed yet. The measurement was taken in the living room. Most of the measured values stayed well below 50 μg/m^3, except for the values of limonene (64.7 μg/m^3), hexanal (48.9 μg/m^3), alpha-pinene (297 μg/m^3) and 3-carene (300 μg/m^3), which differ substantially from the other values. Sarigiannis [13] determined as the average value for Central Europe 17.2 μg/m^3 for limonene, 3.11 μg/m^3 for benzene, 29.8 μg/m^3 for formaldehyde and 12.9 μg/m^3 for alpha-pinene. The benzene (3.11 μg/m^3) and formaldehyde (34 μg/m^3) concentration values measured in this study correspond to the average values reported, while the measured values of limonene and alpha-pinene are significantly higher than the average values given.

Measurement 2:

The interior doors had not been installed, but the air heater had been turned on. The samples were taken in the three most characteristic points of the house. The living room has the largest airspace (123m^3), the 2.room is an average sized room (33m^3), which is not directly connected to the living room, and the room in the attic is 45 m^3. In the samples taken indoors the concentration values of 3-carene (133 μg/m^3) and alpha-pinene (170μg/m^3) decreased considerably compared to the previous measurement as a result of the air heating system. Formaldehyde (11 μg/m^3) and benzene values further decreased (2.79 μg/m^3).

Measurement 3:

The interior doors were installed, except for the attic room, so for this measurement the 3rd sample was taken from the bathroom. Due to the economical operation of the house the air heating had to be turned on much less frequently to achieve an average temperature of 18°C. However, the effect of interior finishing is significant reflected in the value of formaldehyde. Because of cutting the built-in timber to size the formaldehyde value is 130 μg/m^3, which exceeds the 100 μg/m^3 specified by WHO [14]. The significant increase in the value of the acetic acid (138 μg/m^3) may be derived from the silicone grout material. Benzene decreased below the limit of detection. The maximum value of 3-carene is (233 μg/m^3). Alpha-pinene (300 μg/m^3) also increased significantly compared to previous measurements.

Measurement 4:

As an experiment, we increased the indoor air temperature to 21°C by turning on the air heating sytem and under-floor heating. This was an important part of the experiment since this temperature corresponds to the average temperature in the winter period [15]. It was at this time that the highest measured concentrations occurred: 3-carene (300 μg/m^3), alpha-

pinene (300 µg/m^3) is significantly higher than the average, hexanal (79 µg/m^3), and acetate (110 µg/m^3) are moderately different values. However, xylene value in the bathroom increased significantly (104 µg/m^3). Beta-pinene and limonene approach the value of 50 µg/m^3. Formaldehyde decreased below 50 µg/m^3. Benzene (1.66 µg/m^3) still did not come close to the average value of 5 µg/m^3.
During the summer period there were two measurements conducted. The 5. measurement took place during the first heat of summer (outer temperature was 40°C). There was only natural air exchange through the windows.

Measurement 5:

The indoor temperature was 24°C even in the attic. The results show that there is a significant increase of the VOCs concentrations. The aromatic hydrocarbons (toluol, styrene, ethyl-benzene) and the aldehydes (hexanal, benzaldehyde) were two or three times as higher as before, but the terpenes (alpha-pinene, limonene, 3-caren) increased the most with 10 times higher than before. The most TVOCs were detected in the bathroom (9480 µg/m^3). For that the reason is probably that there is no window in room, so the natural air exchange was lower than in the other areas.

Measurement 6:

The results of the 6. measurements showed a surprising decrease of the VOCs concentrations. Despite of the constant heat even in the next month of summer, the indoor temperature did not exceed the 26°C. Each material reduced to the values that were detected at the beginning of the experiment.

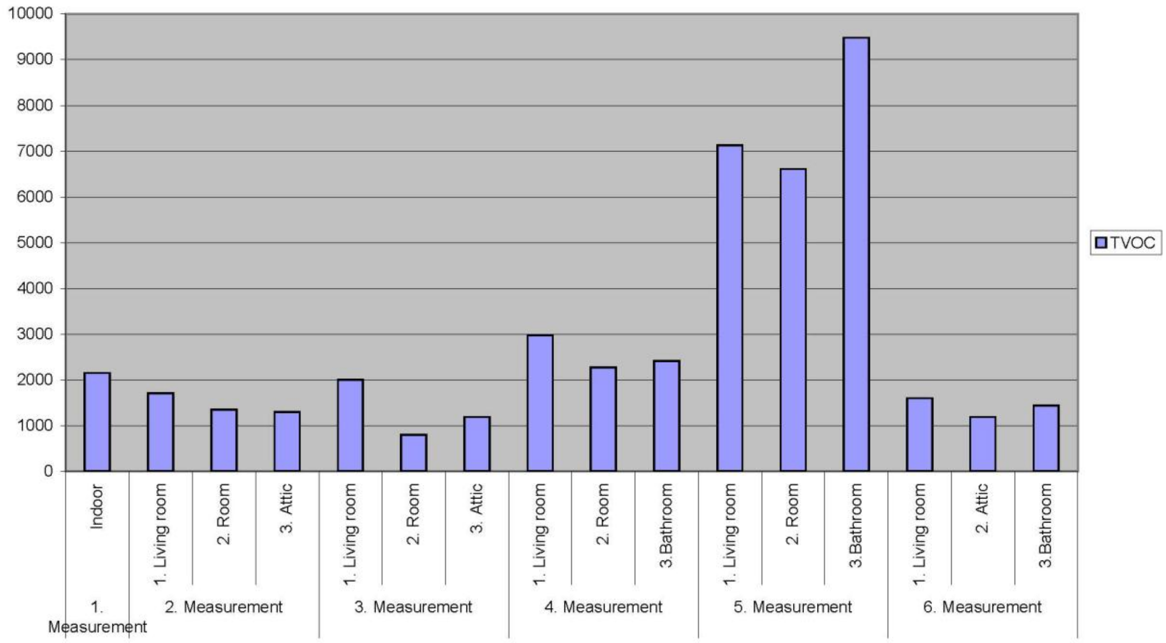

Fig.1: Measured concentrations of TVOCs

The following conclusions may be drawn from the evaluation of the series of measurements of VOC concentrations taken during the seasons:

1. The conditions during the measurements significantly influenced the concentration of certain values (formaldehyde, 3-carene, α-pinene).

2. The significant increase in formaldehyde, 3-carene, alpha-pinene shows that their main source is wood-based building materials.
3. The increase in indoor air temperature may cause the increase in concentrations in the winter period.
4. None of the concentrations of the tested substances remained above the extent of adverse health effects [17].
5. The seasonal variation in indoor temperature may effect the concentrations of indoor sources.

5. CONCLUSION

By summing the measured concentrations of volatile organic compounds, we get the TVOC values. These values are plotted in Fig.1. The graph clearly shows that TVOC concentrations are reduced when the air heating system was turned on. This can be explained by the fact that artificial indoor air movement created a homogeneous concentration distribution. During the fourth measurement when the temperature was heated up to 21°C the under-floor heating was switched on as well. We assume that the under-floor heating may result in an increased concentration of TVOC. This assumption of ours seems to be confirmed by study [16]. During the summer period the measurements showed clearly the effect of the increased temperature by the first part. Probably the frequent natural ventilation indicated the lowering of high VOCs concentrations.

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EFFECTS OF SOIL TYPES AND WASTEWATER SLUDGE APPLICATION ON PLANT GROWTH

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***Abstract**: The application of organic-rich waste material such as municipal wastewater sludges to agricultural soils have a beneficial effect on soil biological, chemical and physical properties, plant growing, soil conditioning. They are rich in nitrogen, phosphorus, and other plant nutrients like boron, manganese, copper, molybdenum and zinc depending on the specific nature of the sludge material. Therefore, there is an increasing interest in the agricultural use of treatment plant with sludge. In this study sunflower, barley, maize, alfalfa and tomato plants were grown on clay loam brown forest soil (Gödöllő), chernozem meadow soil (Szeged), and brown forest soil with thin layers of clay substances "kovárvány" (Nyíregyháza) were treated with high heavy metals content of municipal wastewater sludges (MWS) from Hódmezővásárhely, and low heavy metal content from Nyíregyháza, Hungary. Soil samples were amended with 0, 15, 30, 45 and 60% (w/w) in three replications. The moisture content of MWS treated soils was adjusted to 45% of water holding capacity for eight weeks. Dry weight was determined for each plant and the total nitrogen content in each soil was measured. Results indicated that the soils amended with low heavy metal content from Nyíregyháza improved the plant growth and soil nitrogen compared with the results from soils treated with high heavy metal content of Hódmezővásárhely and untreated soil samples. Application of MWS at high rate of 60% of both MWSs increased the dry biomass of tomato and alfalfa and total nitrogen content in their soils than the other plants and their soils. Chernozem meadow soil type had the best soil productivity over the all combinations with both MWS types. Soils amended with MWSs increased nitrogen content, as compared to the unamended soil samples.*

Keywords: *soil quality, plant growth, soil nitrogen content, municipal wastewater sludges*

INTRODUCTION

Soil is a basic resource for agricultural production systems and soil quality is fundamental to the success of crop production systems. Soil quality is associated with soil biological activity. Soils are fundamental resource for plants and soil organisms. Sewage sludge is a solid waste or by-product of sewage treatment works. Disposal of sewage sludge on agricultural land poses potential threats to ecological sustainability, including the possibility of long term contamination of agricultural soils. There is increasing interest in recycling sewage sludge as a source of nutrients and organic matter for use on the land. Most nutrients and carbon are held in the soil surface, especially, 5-10 cm of the soil profile, and hence this soil layer is important to regulate soil functions and processes (Sparling et al*.,* 2000). Additionally, quality of organic materials strongly influences soil biology and the activity of microorganisms enhances soil properties. Increasing microbial biomass and diversity can contribute to soil microbial activity. The clean and safe environment is the fundamental requirement of human life. Today, due to constraint in availability municipal wastewater sludge (MWS) is being used in agricultural fields. Municipal WS has been recognized as one of the most cost effective and environmentally sound alternatives for organic wastes recycling from sewage water wastes have a potential to substitute inorganic fertilizers.

Municipal WS can be a valuable resource if used as organic fertilizer and soil conditioner. Various studies (e.g., Palese et al., 2009) confirm that treated MWS can be useful as an additional organic matter (OM) resource for agriculture. On the other hand, the MWS its use in agriculture is associated with health risks because of presence of pathogens (Toze, 2006), metallic contaminants like Cu, Ni, Cd, Cr, Zn, etc. and toxic organo-compounds. Soil analysis revealed that organic carbon (OC), phosphorus, calcium and magnesium content were high in sewage irrigated soils compared to tube well irrigated soils (Rana et al., 2010). The immobilized HM may become plant-available with time through natural weathering process or through breakdown of high molecular weight organic-metal complexes. For example, Stacey et al. (2001) have observed that the rate of release of Cd and Zn from a range of biosolids during the decomposition of OM in the biosolids depends, to a large extent, on the chemical composition of the biosolids.

Heavy metal phytotoxicity in soil is determined by the fraction of the metal that is bioavailable. It is important to emphasise that there is a dynamic equilibrium amongst various fractions in soil and any depletion of the available pool due to immobilization, plant uptake, or leaching losses will result in the continuous release from other fractions to replenish the available pool. This is one of the main reasons why there is some reluctance towards using bioavailable pool in soils for regulatory purposes by environmental agencies in monitoring contaminated sites. In addition, the bioavailable pool is sensitive to edaphic and environmental conditions as solubilization of metals from sparingly soluble compounds responds to soil pH, redox potential, temperature, etc. (Stacey et al., 2001).

Soils may become contaminated by the accumulation of toxic HMs and metalloids through emissions from rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, application of fertilizers and manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition (Khan et al. 2008, Zhang et al., 2010). The origin of HM contamination of soils may be anthropogenic as well as geogenic. Land filling and land application of the sludge are suggested as the most commonly recommended disposal techniques (Singh and Agrawal, 2010). However, land filling is not suitable method due to the fact that a large volume of soil is required to cover the waste in order to prevent the leaching of potentially toxic compounds (Chandra et al., 2008). The presence of toxic HMs in soil can inhibit the biodegradation of organic contaminants by microorganisms. Heavy metals are particularly important since high quantities of these metals can decrease crop production due to the risk of biomagnifications and bioaccumulation in the food chain and the accumulation of toxic HMs in crop plants is of great concern because it can enter the food chain. The uptake of toxic HMs by plants is often influenced by plant species, growth stage, soil type, metals and environmental factors. Toxic HM concentration in the soil solution plays a critical role in controlling metal availability to plants (Maimon et al., 2009). However, the availability of the toxic HM ions are influenced by various factors including soil pH, the physical and chemical properties of soil, the clay content and manganese oxide concentration. Phytoremediation is defined as the use of plants to remove pollutants from the environment, is a promising technology for the remediation of contaminated soils and perhaps for the removal of metals from contaminated soil (Dede et al., 2012). This technology can be applied to both organic and inorganic pollutants. Sunflower is able to secrete organic acids which acidify the rhizosphere and increases the solubility of toxic metals like Pb and Cu (Cunningham and Berti 2000).

Today, the world relies on increasing crop production to meet the increasing demand for food. However, this trend cannot be maintained due to decreasing cultivable land for rapid urbanization. In order to increase world food production in a sustainable manner, agricultural land should be amended with amounts of organic fertilizers which is not very costly and make the environment safety. Additionally, more than 50% of the applied inorganic N-fertilizer is always lost through different processes e.g., denitrification and consequently may make environment pollution. Amendment of MWS led to significant increase in heavy metals e.g., Pb, Cr, Cd, Cu, Zn and Ni concentrations of soil (Singh and Agrawal, 2007)._The bioavailable pool of metals, estimated as free ion activities, decreased with the increasing occurrence of metal-organic matter complexes (Hernandez-Soriano et al., 2013).

Monitoring is needed to encourage the use of wastewater sludge in agriculture and to regulate its use to prevent harmful effects on soil, crop, animal and man (Bayoumi Hamuda and Ligetvári, 2011). The main aim of this study is to investigate the effects of municipal wastewater sludges on plant growth, and N content in different soil types.

MATERIALS AND METHODS

Table 1 represent the pH, organic matter and nitrogen and heavy metals contents in used soils and MWS in Table 2. Soil samples were taken from the plough layer at 0-20 cm depth.

Table 1

Summary of some physicochemical properties of investigated soil samples

Parameters	Soil samples		
	Nyíregyháza	Gödöllő	Szeged
	Kovárvány Brown Forest	clay loam brown forest	Meadow Chernozem
pH(KCl)	5.78	4.72	6.20
Humus (%)	2.54	1.24	3.55
Total N, mg/kg	54.3	8.411	34.7
Zn (mg/kg)	1.70	38.1	1.10
Cu (mg/kg)	1.40	22.9	2.4
Cd (mg/kg)	1.70	0.18	1.02

Pb (mg/kg)	1.30	15.1	0.96

Table 2

Summary of some physicochemical properties of investigated wastewater sludges

Parameters	Wastewater sludges samples	
	Nyíregyháza	**Hódmezővásárhely**
$pH_{(KCl)}$	6.71	**7.8**
Humus (%)	21.7	**20.4**
Total N, mg/kg	7470	**43311**
Zn (mg/kg)	537	**1068**
Cu (mg/kg)	110.4	**182.3**
Cd (mg/kg)	2.3	**4.168**
Pb (mg/kg)	66.9	**540.7**

In this study sunflower, barley, maize, alfalfa and tomato plants were grown on different soil types. The used soils were: clay loam brown forest soil (Gödöllő), chernozem meadow soil (Szeged) and brown forest soil with thin layers of clay substances “kovárvány” (Nyíregyháza) were treated with different application rates (0, 15, 30, 45 and 60% (w/w)) of high heavy metals content of MWS from Hódmezővásárhely, and low heavy metal content from Nyíregyháza, Hungary. The moisture content of MWS treated soils was adjusted to 45% of water holding capacity for eight weeks. Dry weight (70°C) was determined for each plant and the total nitrogen content in each soil was measured by the micro-Kjeldahl method (Bremner, 1982). The results are presents as relative plant dry matter in comparison with control.

RESULTS AND DISCUSSION

The application of organic-rich waste material such as sludge to agricultural soils can have a beneficial effect on soil biological, chemical and physical properties, plant growing, soil conditioning. Wastewater sludges contain high levels of organic matter that may contribute to the observed ability to limit metal solubility (Li et al., 2000). Results indicated that the soils amended with low heavy metal content from MWS from Nyíregyháza improved the plant growth of all plants as well as soil nitrogen content in comparison with the results from soils treated with high heavy metal content originated from Hódmezővásárhely and untreated control soil samples. Application of MWS at high rate of 60% of both MWSs increased the dry biomass of tomato and alfalfa and total nitrogen content in their soils than the other plants and their soils. Chernozem meadow soil type had the best soil productivity over the all combinations with both MWS types. Soils amended with MWSs increased nitrogen content, as compared to the unamended soil samples.

Results revealed that dry weight of sunflower increased with application of sludge in all soil types but there were not observed any significant effect on sunflower dry weighs within the application rates (Figure 1). Maximal plant dry of sunflower was observed at 45% application rate on all soil types treated with both MWSs. The best dry weight of sunflower was determined when the plant grow in chernozem meadow soil type amended with MWS obtained from Nyíregyháza. Lower application rates did not show any significant in the plant growth. Figure (2) shows that barley plant dry weight was significantly improved especially at 45% MWS application rate when it is cultivated in clay loam brown forest soil of Gödöllő and treated with MWS from Nyíregyháza comparing with its growth at different soil types with different MWS amendments. Maize plants grew differentially but not significantly in all soil types treated by different application rates of the two MWS. Maximum plant dry matter was found when the plant was cultivated in chernozem meadow soil type treated with 45% of MWS from Nyíregyháza. At this application rate, maize plant can grow better in clay loam brown forest soil of Gödöllő as well as in Kovárvány Brown Forest from Nyíregyháza treated with also MWS from Nyíregyháza. Maize plant can grow better at 60% application rate of MWS from Nyíregyháza than in soils treated with MWS from Hódmezővásárhely (Figure 3).

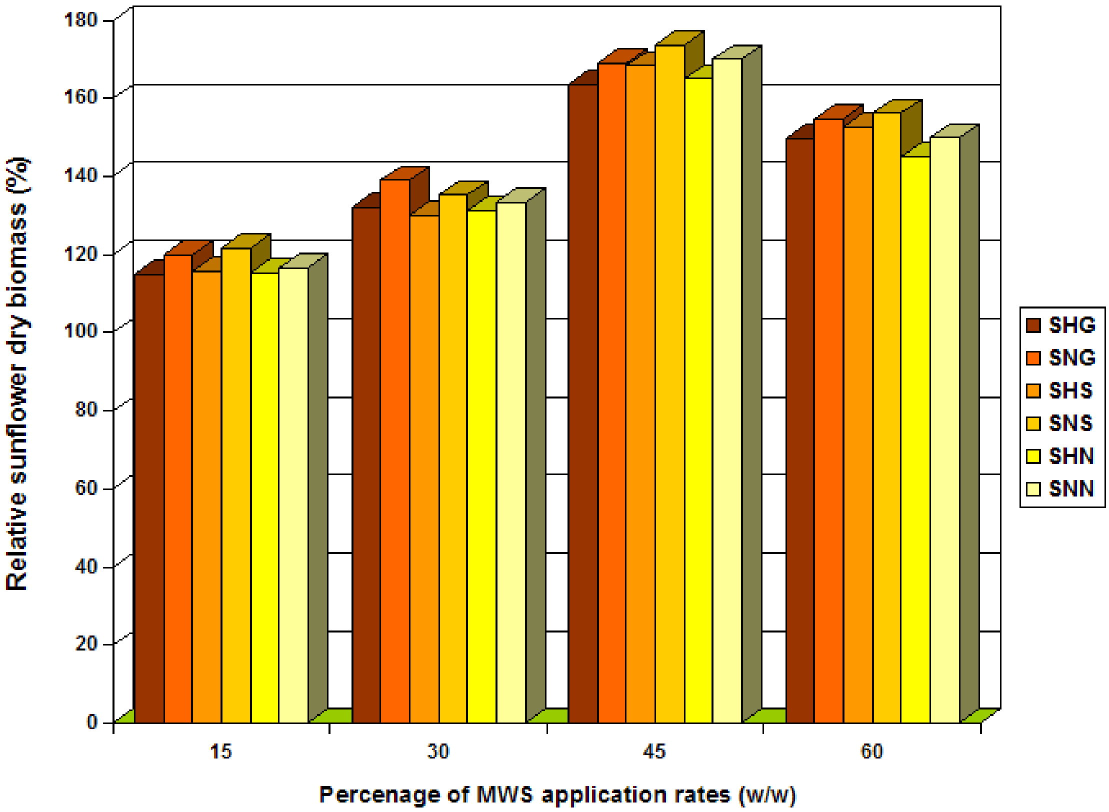

Figure 1 Effects of municipal wastewater sludges (SH: Hódmezővásárhely and SN: Nyíregyháza) application to different soil types (G: Gödöllő, S: Szeged, and N: Nyíregyháza) on the growth of sunflower dry weight

Figure (4) demonstrates that alfalfa dry weight was stimulated by the application of the two MWSs at all application rates even at 60%. Also, the result indicated that alfalfa can grow in all soil types under all amendments. The best plant dry matter was recognized when alfalfa cultivated in the investigated soil types and treated with MWS from Nyíregyháza. Similarly, Tomato plant dry weight was at maximum when cultivated in all tested soil amended with MWS from Nyíregyháza (Figure 5). The growth of tomato plant did not affected by high application rate (60%).

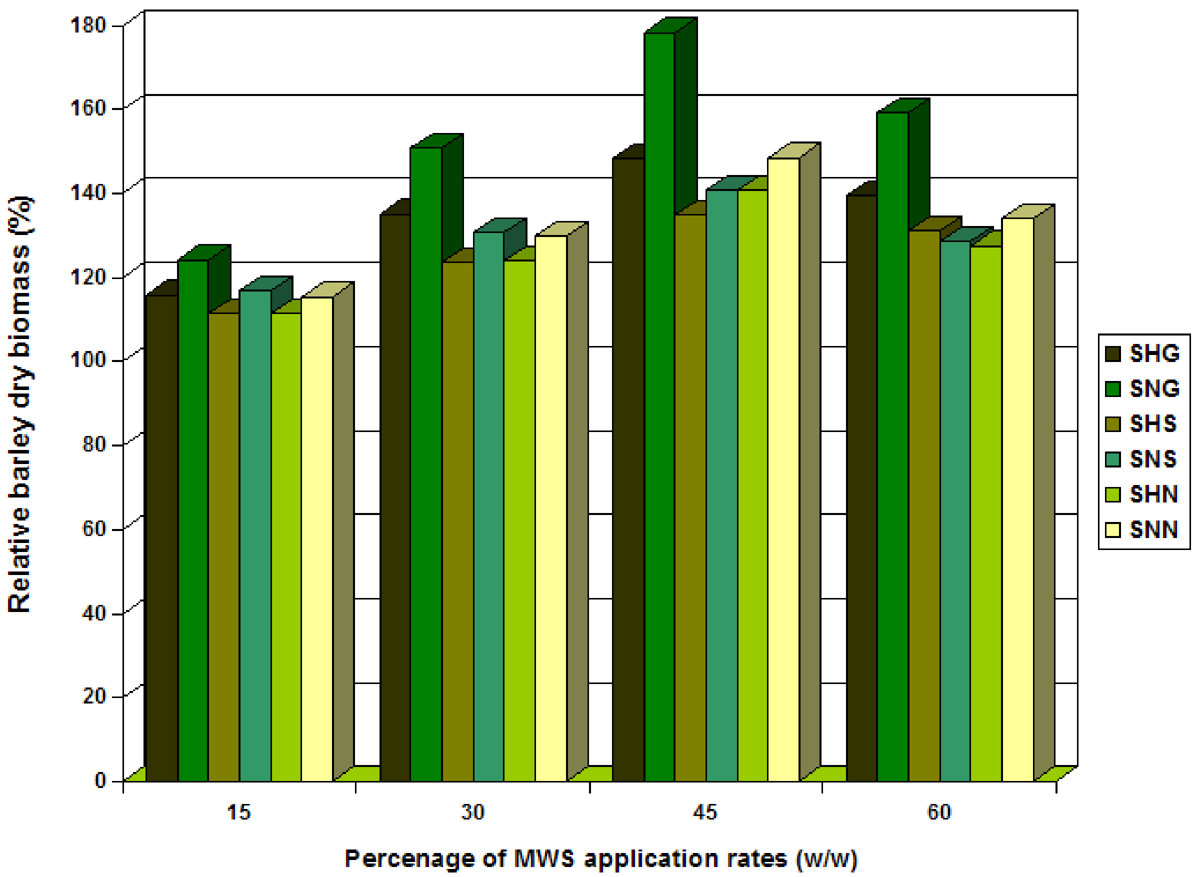

Figure 2 Effects of municipal wastewater sludges (SH: Hódmezővásárhely and SN: Nyíregyháza) application to different soil types (G: Gödöllő, S: Szeged, and N: Nyíregyháza) on the growth of barley dry weight

The results showed that application of MWS to the soil improve the soil quality by increasing the total nitrogen content. Table 3 illustrates that at 45% application rate of MWS applied to the assessed soil types, the total nitrogen content in all soils increased. Application of MWS from Hódmezővásárhely increased the total nitrogen content in the soils especially Kovárvány Brown Forest from Nyíregyháza. More nitrogen was measured in this soil type when cultivated by alfalfa and sunflower plants, while when the soils were amended with MWS from Nyíregyháza, chernozem meadow soil type had the highest values of total nitrogen content compared with other two soils. Highest amount of nitrogen was recorded when the this soil cultivated by sunflower.

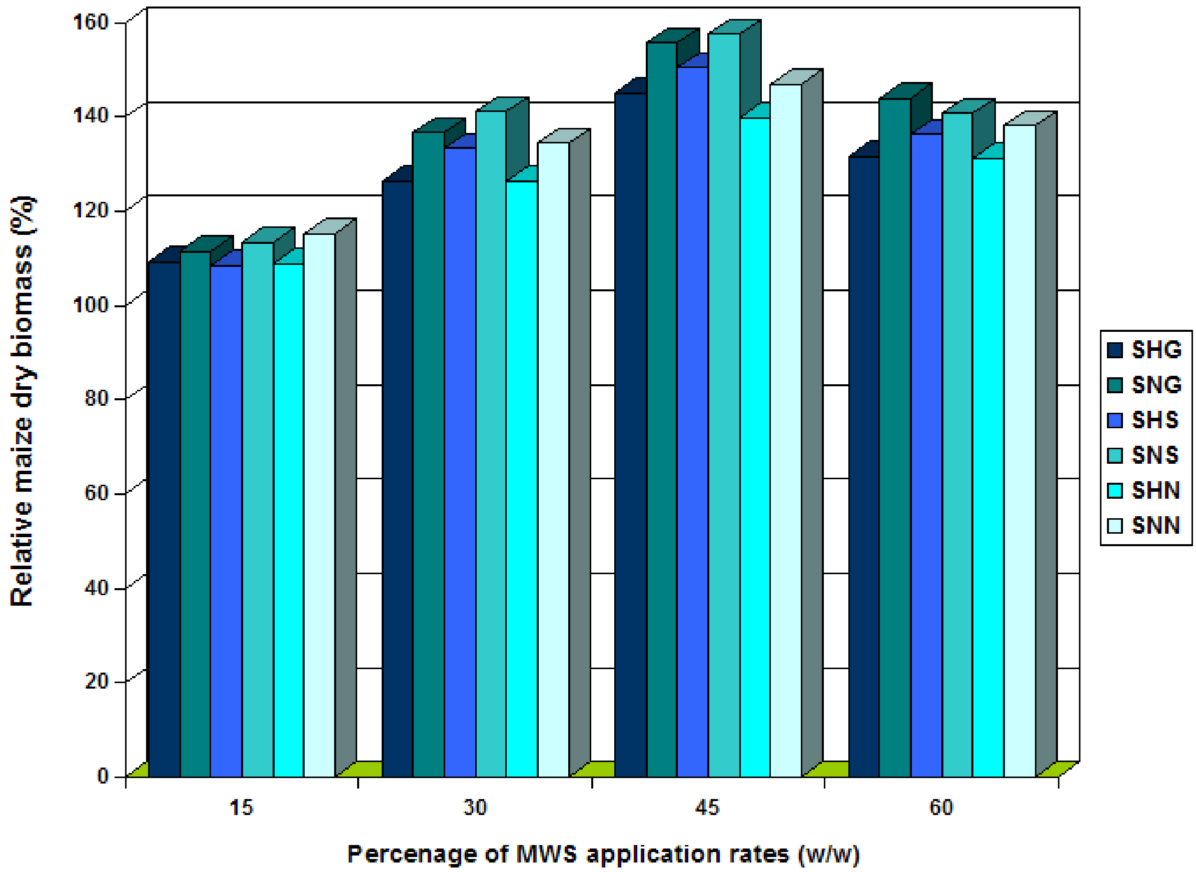

Figure 3 Effects of municipal wastewater sludges (SH: Hódmezővásárhely and SN: Nyíregyháza) application to different soil types (G: Gödöllő, S: Szeged, and N: Nyíregyháza) on the growth of maize dry weight

The application of MWS to soil has become common practice due to its increased production, the reduction of available disposal sites and its potential to increase soil fertility. Soil organic matter plays an essential role in nutrient (N, P, S, K) cycles, soil stability and the ecological and environmental aspects of sustainability of soil fertility. The content, behaviour and significance of HMs in composted waste materials are important from two potentially conflicting aspects of environmental legislation in terms of defining end-of-waste criteria and increasing recycling of composted residuals on land and protecting soil quality by preventing contamination (Smith, 2009). All types of municipal solid waste compost contain more HMs than the background levels present in soil and their contents will increase in amended soil.

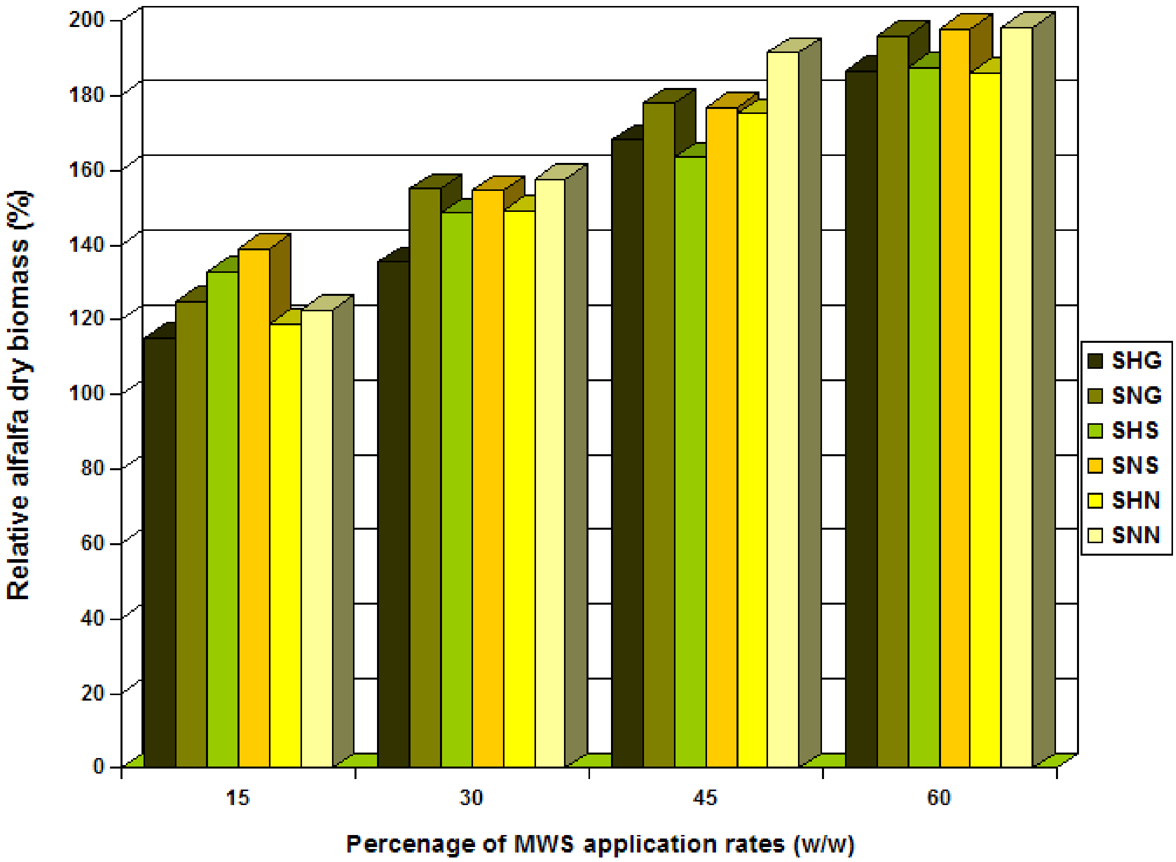

Figure 4 Effects of municipal wastewater sludges (SH: Hódmezővásárhely and SN: Nyíregyháza) application to different soil types (G: Gödöllő, S: Szeged, and N: Nyíregyháza) on the growth of alfalfa dry weight

Haghighi et al. (2010) showed that organic matter application in soil immobilized Cd and reduced its toxicity in lettuce. Our results had similar trend when the plants were grown in soils treated with high heavy metal content of Hódmezővásárhely. There is general consensus in the scientific literature that aerobic composting processes increase the complexation of HMs in organic waste residuals, and that metals are strongly bound to the compost matrix and OM, limiting their solubility and bioavailability in soil (Smith, 2009). Lead and Cu concentration were positively correlated to the TPDB due to the increased plant tissue to accumulate more HMs. Furthermore the higher TPDB indicates that plants were bigger and probably possessed higher absorption rate so that more HMs uptake took place (Ho et al., 2008). Our results were in an agreement with Rahman et al. (2013) who mentioned that the Pb and Cu uptake ability of sunflower was appreciably greater than Indian mustard and amaranth. There was a positive relationship between N fertilizer application on plant growth and their ability to absorb Pb and Cu. The plant N content directly or indirectly affected the HM concentrations in the plants, by boosting the biomass of the plants and subsequently their ability to accumulate more HMs. This positive correlation suggests that inorganic or other types of fertilizers, such as organic fertilizers, can be used to increase the biomass of plants and their capacity to accumulate HMs from the soil.

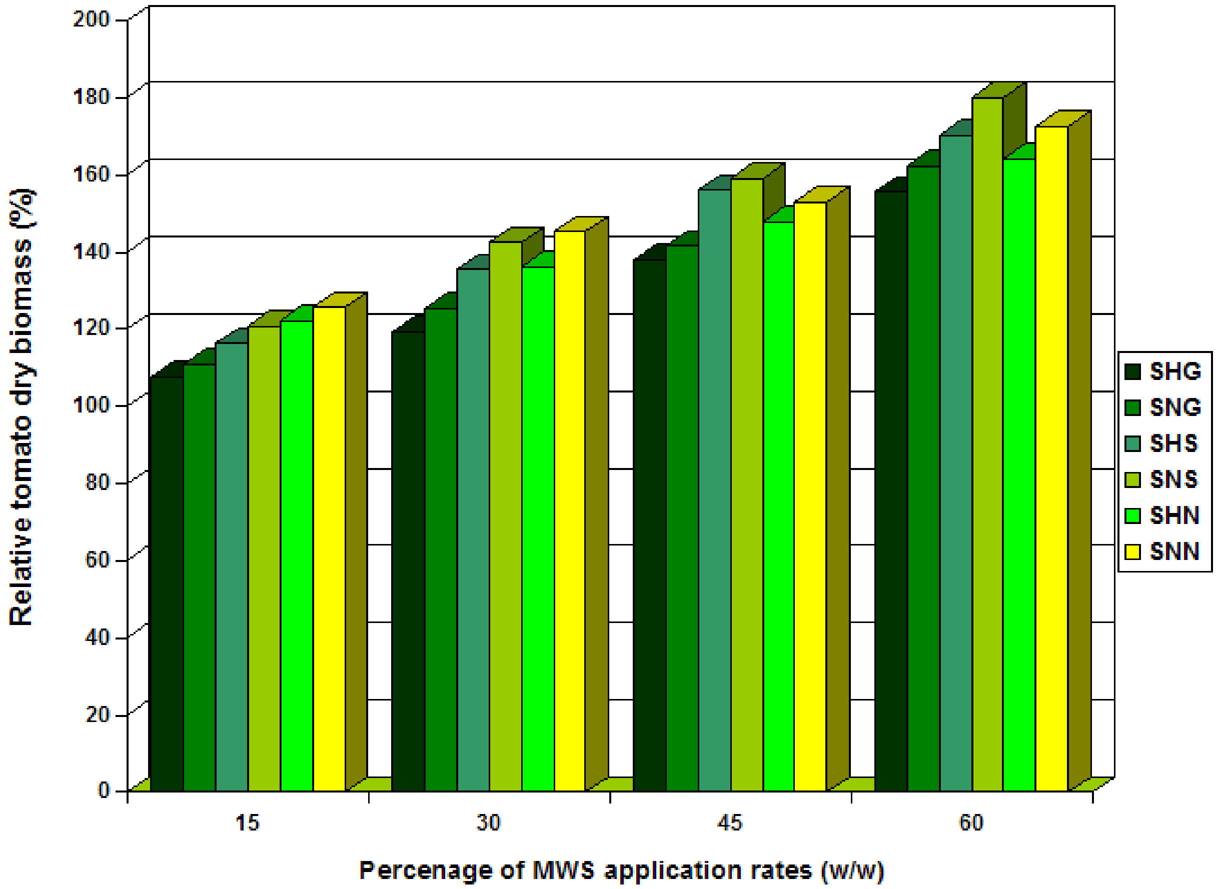

Figure 5 Effects of municipal wastewater sludges (SH: Hódmezővásárhely and SN: Nyíregyháza) application to different soil types (G: Gödöllő, S: Szeged, and N: Nyíregyháza) on the growth of tomato dry weight

Table 3

Effects of municipal wastewater sludges at 45% application rate to different soil types on the total nitrogen content

Plants	Municipal wastewater sludges and soil types					
	Hódmezővásárhely			Nyíregyháza		
	Gödöllő	Szeged	Nyíregyháza	Gödöllő	Szeged	Nyíregyháza
Sunflower	240.611	270.063	288.100	223.167	338.451	293.657
Barley	230.231	234.511	262.566	200.311	232.546	221.207
Maize	231.568	235.332	268.102	201.441	221.034	211.401
Alfalfa	243.511	277.122	289.122	201.544	251.686	251.111

Tomato	223.588	227.613	240.662	198.430	244.659	212.522

In addition, wastewater sludges generally contain high concentrations of Fe and Mn. The alternating aerobic and anaerobic conditions in wastewater treatment plants combined with the high organic matter and Fe content of wastewater sludges suggest that the formation of ferrihydrite is favoured and the crystallization of this oxide may be inhibited. Ferrihydrite has been shown to form surface inner sphere complexes with Pb (Scheinost et al., 2001).

Generally organic matter increase plant micronutrient up-take like Fe, Zn and Cu in low and essential concentration reported in cucumber, melon and bentgrass due to their ability to complex metals and promote plant growth (Garcia-Mina et al., 2004). Our results (Figures 1-5) were confirmed by the conclusion of Garcia-Mina et al. (2004)

CONCLUSIONS

Soil amended with MWS potentially improves growth of the plant cultivated in different soil types. Along with the results of this study, the comparison between control and treatments with MWSs showed that sludge application increase the relative dry weight due to improvement of photosynthesis rate of leafy vegetable and nutrient uptake.

Concerning the flow of C and energy the microbial activity and biomass, our results showed that it may depend on the soil type and soil components. Agricultural utilization of MSW is the most cost-effective MSW management option over traditional means such as land-filling or incineration as it enables recycling of potential plants nutrients. However, more research is needed to assess the environmental risk of application of high HMs content MWS under field conditions. Also, research is needed with different soil types and MSW amendment rates to evaluate the effect of MSWC application on soil microbial biomass and reach the final conclusion.

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THE DUST MEASURING OCCURING IN PROGRESSIVE PLASMA TECHNOLOGY OF MATERIALS

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Abstract: *The present contribution deals with hazard identification and risk at the technological plasma workplace. Specific welding method allows to mechanise and to automate the welding process, which in addition goes to increasing the quality and productivity of work and decrease the production waste. It also reduces the possibility of threats to staff. The dustiness is among the risks to employees on plasma workplace. The main source of dust is welding or cutting in plasma operations, in which plasma ray comes into contact with the material. In the paper there are presented also results of dust measurement on this type of workplace.*

Keywords: *plasma workplaces, environmental safety, working climate*

INTRODUCTION

The development of climate change and the development of other environmental impacts of unsustainable patterns of production gradually changing the behavior of most production firms. The rules of the market are beginning to gradually expand about the environmental requirements.
The main contribution of production firm to environmental sustainability is decision and act making in three directions:

- choice of environmentally suitable technologies,
- production of environmentally friendly products,
- optimum operation of existing technologies with the aim to the maximum limit of their negative impacts on the environment.

RISK FACTORS OF WELDING PROCESS

The risk analysis in the society was focused on the application of the system of health and safety at work, it means, the existence of a management system, its documentation (internal regulations, directives, orders of the Director and others), their application in the business companies, and the implementation of safety and protective systems in the company workplace (own resources). For safety, security and environmental systems, the analysis was focused on the technical solution of safety and protection systems, which are required by the provisions of applicable laws, government regulation, and Slovak technical standards, with regard to the applicable World and European Union directives. [2].
Welding technology is the process of joining materials into permanent units. Depending on the used welding technology we can speak about the fusion, fusion-pressure and pressure welding methods. In terms of the harm, the fusion welding processes have the greatest impact on the human body [3].

In these methods arise variety of harmful adverse-risk factors that may be under instruction of the Ministries of Health EU implemented into sanitary surveillance in the workplace and we divide the statements of hazardous work into [3]:

- specific risk factors,
- non-specific risk factors.

We include into the specific risk factors: dust (solid aerosols), noise, vibration, chemicals and chemical carcinogens, infection, allergens, ionizing radiation, electromagnetic radiation, increased pressure on the nerves, limbs etc. [1,2,3]
The physical exercise, work location, microclimate, lighting, mental stress welder belong to non-specific risk factors.
The risk factors and limit values for pollutants for welding workplaces define the Slovak standards as STN 05 0600, STN 05 0601, STN 05 0610, STN 05 0630 and others.
The protection issues of health and safety of employees at the work with chemical agents is governed by the legislation of the Slovak Government Regulation 355/2006 about the protection of workers from risks related with the exposure by the chemical agents at the work. In Annex 1 of this regulation is established the maximum permissible exposure limit for welding solid aerosols on the value 5 $mg.m^{-3}$, it means the total concentration of solid aerosols. The Fig. 1 shows the effect of various influencing parameters on the occurrence and amount of pollutants during welding.

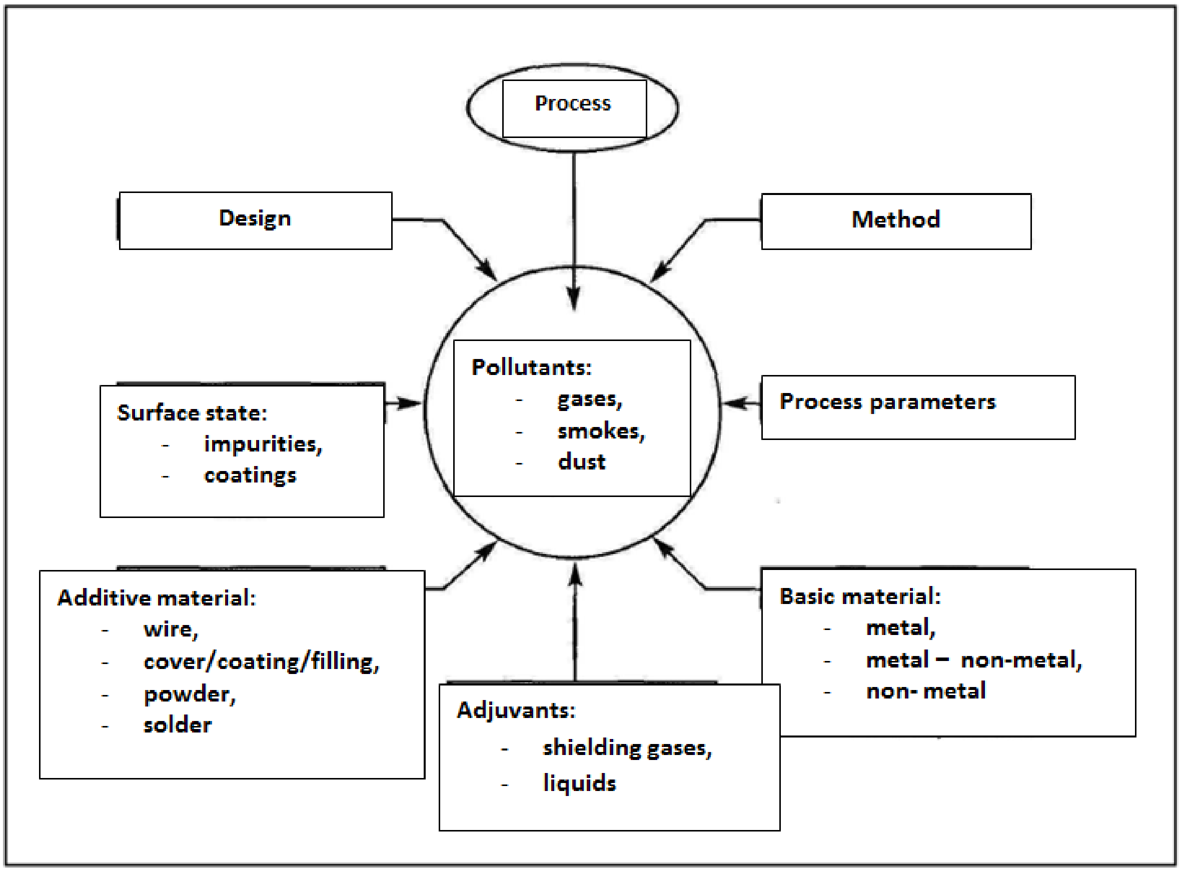

Fig. 1 Environmental risks of harmful substances in welding

PLASMA WELDING TECHNOLOGY

The plasma as the fourth state of gas occurs at very high temperatures of up to 20 000°C. The Fig. 2 shows the temperature field in various types of plasma radiation.

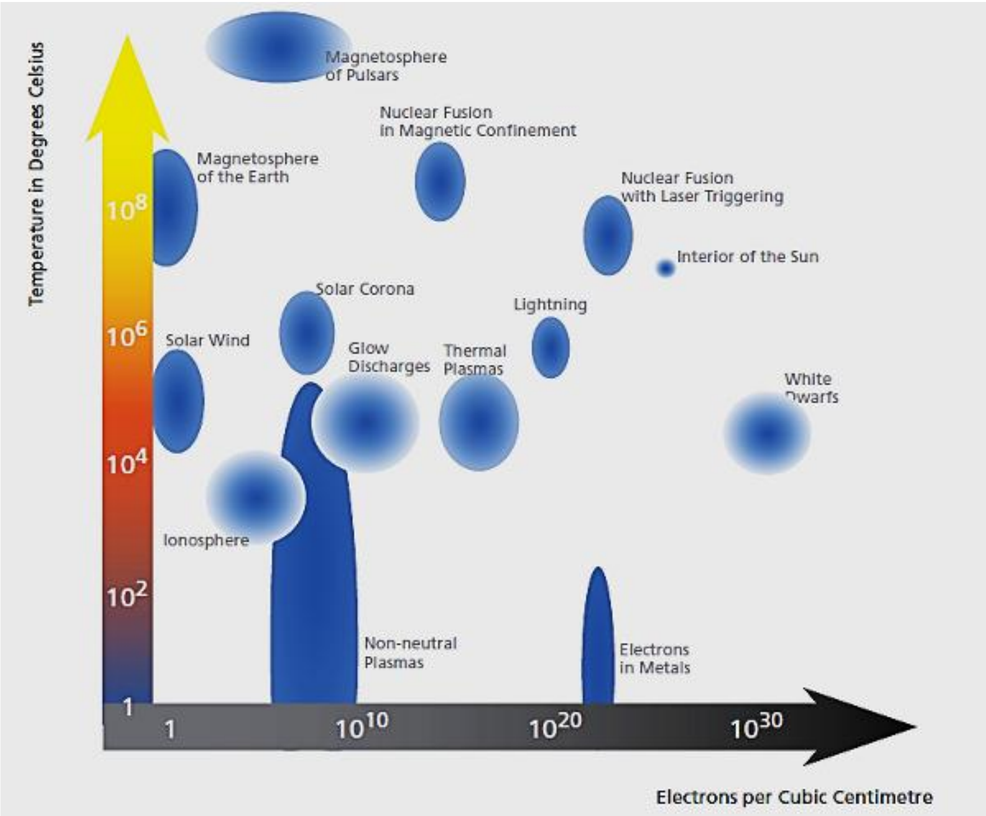

Fig. 2 The dependence of electron density

Among the advanced techniques of plasma technologies (PBM) are included, Fig. 3:

- dry plasma without secondary gas,
- dry plasma with the secondary shielding gas,
- plasma cutting under water with the secondary shielding gas.

The source of risk for plasma arc welding is most frequently:

- electrical current (up to 600A),
- radiation of all wavelengths, but especially ultraviolet, which is much more intensive than in open burning electric arc,
- arc rays,
- harmful gases and aerosols, mainly in particular ozone and nitrous gases,
- noise that reaches particularly high levels (up to 110 db), which dominates high-frequency component,
- fire hazard .

The qualitative risk is similar as the arc welding, but quantitatively the intensity of all the factors is much higher. Therefore, plasma workplaces must have more aerospace and more intense suction than other arc workplaces and also should be fitted with protective walls and acoustic damping partitions and paneling.

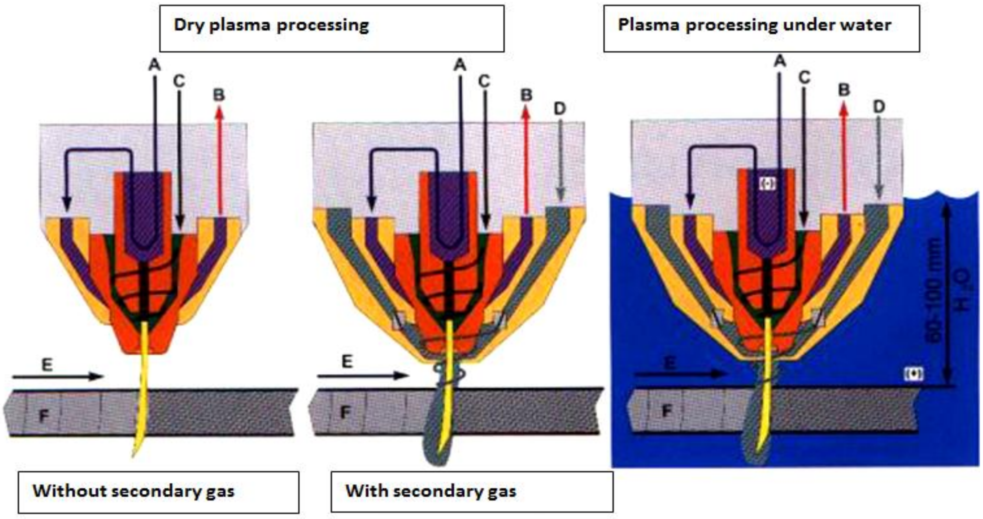

Fig. 4 The concept of modern types PBM17 [4]

A) Water supply, B) Drainage, C) Gas, D) Shielding gas, E) cutting direction, F) Depth of cut

Depending on the type of plasma workplace, the requirements for removing pollutants from the work area are different. We know the different types of plasma workplaces:

- handheld plasma workplaces,
- robotic plasma workplaces,
- semi-automated plasma workplaces,
- plasma workplaces that allow welding underwater,
- plasma workplaces with fixed working table,
- plasma workplaces with movable working table.

The Fig. 4 shows the robotic workplace intended for plasma thermal and mechanical cutting of conductive metal, where the air is used as the plasma medium.

The plasma welding under the water level is shown in Fig. 5. In this method, welding gas emissions are reduced by welding underwater. The Fig. 6 shows plasma welding workplace with solid desk and torches fixed to the movable portal.

The detail design segment desk with suction is shown in Fig. 7. The extraction of dusty air forming during cutting or welding is carried through the pipe, which air is discharged to filter On the surface of the filter element is made separation of dust from the air. In order to ensure a stable work, the maintainance of the equipment during operation is necessary and is carried out by the cleaning of filter. The special design of the segment suction table, Fig. 7, allows you to limit the force required during extraction, as well as increase its effectiveness. The individual segments are subjected to suction when they are in the process of cutting or welding. The system sensor of control damper is careful to work while only one section is working. The built initial cleaning, it means that the special construction of segment ensure installation against leakage of hot and heavy dust that could damage the elements of filter ventilator. The removable containers for dust and slag allow to quick and easy cleaning of the table. Section suction tables allow to efficient drainage.

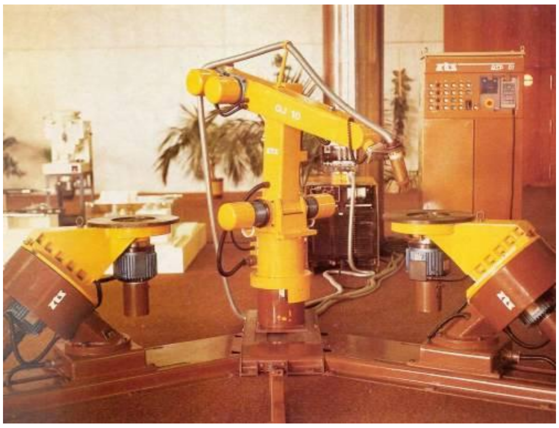

Fig.4 Robotic Plasma workplace OJ- PR 10

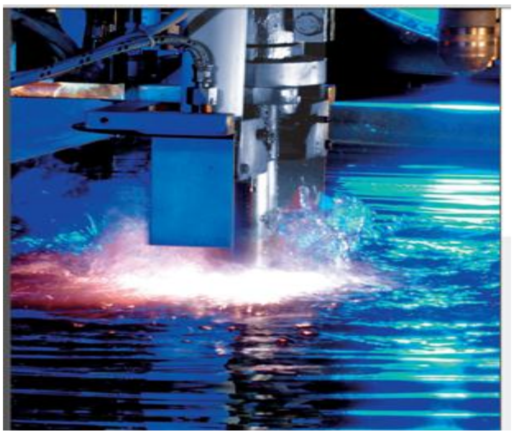

Fig.5 Preview plasma welding under water

Fig. 6 Plasma workplace with fixed table

Fig. 7 Segment suction table

DANGER AT THE WELDING OPERATION

The breeding hazards, it means the complex harmful and dangerous factors, the existence of which is connected with a sources of energy, needed to create the weld (heat, mechanical force, respectively other different sources), as well as with the metallurgical welding process and other negative factors resulting from the specific conditions at welding jobs.
Against such threats is necessary to protect the welder:

- with the corresponding solving of weld working place and its equipment,
- with the realization of technical measures on the sources, built dividing walls and acoustical treatment in the work space,
- with ensuring of welder with appropriate personal protective equipment (PPE) according to the type of welding,
- with not exceeding of the maximum allowable time exposure, while it cannot adequately protect with the equipment to prevent of the exposure of harmful agents (ionizing radiation).

If a particular welding method enables, it necessary to mechanize and automate this process, which in addition increases the quality and productivity of work. It also reduces the possibility of threats to staff by further away from the source of the threat and moving to a more suitable working environment (control rooms).

Releasing of the fumes, gases, vapors, aerosols and dust during welding of materials, which most of them are toxic or fibrogenic. They come from metallurgical process of welding and supporting physic-chemical reactions of participating substances, it means also from the potential protective coatings and degreasing equipment on basic welded materials.

The amount and type of pollutants depends on the method and welding conditions, but also on the type of base and additive material. The severity of harmful substances in emissions reflect the exposure limit values for these substances and biological limit values laid down in the relevant legislation. The pollutants can be divided into:

- gaseous toxic components that prevent the transport of oxygen in the blood, they can cause respiratory paralysis, poisoning, pulmonary edema, (they are mainly oxides of carbon, nitrogen, ozone, phosgene, chlorine, chloride, hydrogen fluoride, hydrogen cyanide, etc.),
- solid product that directly threaten the lungs (oxides of iron, aluminium, manganese, sodium, potassium, titanium, and other metals), but also are toxic to the individual organs of the human body (kidneys, nerves, lungs, bones) or potential carcinogens (hexavalent chromium, nickel oxide, cadmium, cobalt, beryllium).

Harmful effects of emissions must be restricted (→ breathing zone):

- choice of welding technology (which, however, for given required weld quality is not always possible),
- restricting of access of harm into breathing zone of the welder by exhausting with ventilation,
- use of personal protective equipment (PPE).

For easier evaluation of the effects of **the group of "welding fumes"** are dividing**:**

- dust (aerosol), which, related with the exposure of chemical agents at work evaluates as **welding solid aerosol**, which is classified as solid aerosols with possible fibrogenic effect with separate threshold limit value (TLV),
- chemical factors with the toxic effect, because gases, vapours and aerosols predominantly toxic effects that are found in welding fumes are presented in government regulation set TLV and their health effects, and thus the health risk assessments are different.

REALIZATION OF MEASUREMENTS IN CONCRETE WORKSTATION

The realization of measurements, it means, at the sampling is based on the European Standard STN EN 689: Atmosphere on the workplace. The guidelines for the evaluation of exposure by inhalation of chemical agents for comparison with limit values and measurement strategy. The standard defines the measurement procedure and also the measurement strategy.

The sampling was used for the following instrumentation:

- personal sampling pump, type AirChek2000 made by SKC (Fig. 8),
- plastic sampling head, type made by SKC IOM (Fig. 9),
- Flow Calibrator, type DC-Lite from the company SKC,
- glass fiber filters from SKC company.

For evaluating of samples were used analytical balance with accurate to 0.1 mg, type AP250DE made by Ohaus and desiccator to stabilize of filters.

Fig. 8 IOM sampling head

Fig. 9 The sampling pump

The methodology of sampling

Before the sampling is necessary to identify what type of solid aerosol will be taken. Depending on the selected type of the sampling, head and the filter type will be chosen.
The sampling of solid aerosols can be carried personally and stationary, and is preferring personal collection. At the personnel sampling the sampling system is placed directly on the employee, and the sampling head is placed in the breathing zone of person (30 cm from the nose and mouth of the employee). At the stationary sampling, the suction part of the sampling apparatus is affixed to the height, which corresponds to the breathing zone of workers. The stationary sampling place selection depends on the purpose of measurement.
The sampling time is minimally 25% of the duration of exposure of solid aerosol, and in the event that there are no significant changes in exposure.
After samples are taken, the exposed filters are transported to the laboratory, where they are stabilized in a desiccator and then are weighed. An identical procedure is also realized before the starting of the tests, it means the stabilization and weighting of clean filters. From the record is then calculated exposure concentration of solid aerosols in the working environment.

5.2 The sampling and measurement results

On the workplace were realized two types of donations and personal and stationary samplings. Both samplings were taken at the same time. Personal sampling was made at the employee, who was serving of plasma workplace (plasma operator), and who was working and moving on workstation and perform standard business operations. Stationary sampling was located 1.5 m from the plasma table at 1.5 m above the floor level of the production hall, Fig. 10 and Fig.11.

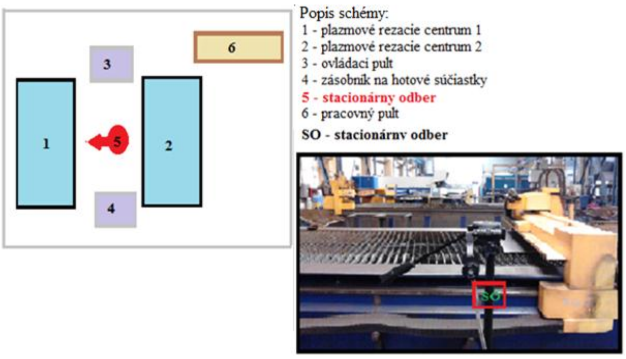

Fig. 10 Stationary taking of samples

Fig. 11 Personal taking of samples

The sampling time was 90 minutes and flow rate pump was set to 2 $lmin^{-1}$.
Length of the workday is 8 hours, and employees are not exposed to aerosols fixed throughout the changes. During breaks, the employee were moving at the areas outside, away from the fixed aerosol exposure and after reduction of breaking time the total duration of exposure is 440 minutes.
Before and after measurements were recorded climatic conditions at the place of measurement:

- air temperature: 21°C ,
- atmospheric pressure: 97.5 kPa,
- humidity: 47% .

From the obtained results then were determined the fixed exposure concentration and was evaluated the consistency, respectively inconsistency of the results with the requirements determined in the legislation.
In Tab. 1 are shown the measured values, and the calculated values from the experimental measured values and also was made an assess compliance.
During the evaluating of the measuring results are the results and calculated results compared with TLV listed in Annex 1 of Slovak Gov. Regulation no. 471/2011 and from this Regulation for solid aerosols are determined as the average exposure concentration of total solid aerosol TLV-c, as satisfying one, we evaluated, if this exposure value was not exceeded. For welding solid aerosols was determined TWA-c = 5 mg.m^{-3}, as it is shown in the Tab.1.

Tab.1 Measurement results

M	Position	The taking place	The measured concentration [mg.m^{-3}]	The assessed value [mg.m^{-3}]	TLV-c [mg.m^{-3}]	Compliance/ non-compliance
1	Table of plasma	stationary	1,13	1,07	5	satisfied
2	Operator of plasma	personal	1,79	1,71	5	satisfied

Based on sampling and their evaluation, there was found that the concentration of solid aerosol exposure to the plasma at the workplace was at:

- personnel taking of 1.71 mgm^{-3},

• stationary collection of 1.07 mgm^{-3},

thus we can make a conclusion that TLV-c by Slovak Government Regulation no. 471/2011 was not exceeded in each case.
Since plasma welding and cutting technologies produces a significant proportion of pollutants, contributed to this result, therefore in the plasma workplaces are used evacuations. So a significant proportion of generated pollutants during operations are sucked and filtered. The filtered air, free of pollutants is returned back to the workplace. At the same time it will reduce the share of pollutants discharged into the environment.
As the legislative limitation of maximum exposure limit is not exceeded, it is necessary to propose appropriate measures in the plasma workplace.

CONCLUSION

This contribution was intended to provide initial information regarding to the environmental safety of plasma workplaces.
It is important to note that the chemical composition of smoke, the intensity of their production size distribution (particle size and structure of the solid aerosols) depend from the manner, respectively from the welding technology, from the composition of the filler materials for welding and basic materials, shielding gases, procedures and process parameters, from the maximum working temperature during the welding and from the eventual surface finish of welded materials.
Nevertheless, there is a presumption that due to an expanding shortage of skilled welders in the Slovak labour market, the employers will be in effort to sustain a skilled workers into workplaces to take care more about the health of their employees and to provide them with relevant technology and technical equipment of workplaces with quality ventilation equipment, thereby they will achieve a quality work environment.

Acknowledgement

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AIR-CONDITIONING EFFICIENCY IMPROVEMENT

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Abstract. *Decreasing energy resources of the Earth and enhanced energy consumption are typical of our life. However, one of the basic conditions to survive is that the amount of the energy used every day should be reduced. This article presents a solution to the problem. The energy used to air-condition a room and the possible use of secondary energies generated by the air-conditioning is studied in the research. The heat energy distracted by a heat pump out of the room is not let outside as heat loss, but it is used for making domestic hot water. The efficiency of the heat pump is examined with varied air parameters inside.*

Keywords: Heat pump, air-conditioning, effectiveness, coefficient of performance (COP), domestic hot water supply.

INTRODUCTION

In general, the purpose of air-conditioning is to generate temperature lower than the ambient temperature and keeping it constant inside the room to air-condition [8]. In practice, heat pumps driven by an electric compressor are generally used. The ratio of the heat energy expressed by the heat pump and the energy taken from the electric supply for driving the compressor (and the fans) is called the coefficient of performance of the cycle. The higher the coefficient of performance of a heat pump is the more economic it is, it varies between 2 and 5 according to the structure of the heat pump, the ambient temperature outside and the way of application. See the schematic diagram of a heat pump in Figure 1.

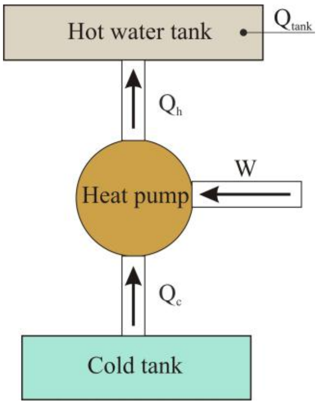

Figure 1 Schematic diagram of a heat pump

The following relation can be described between the energies in Figure 1:

$$Q_h = Q_c + W \tag{1}$$

where:

Q_c	the heat distracted from the room	[*J*],
Q_h	the quantity of heat expressed to the hot water tank	[*J*],
W	electric energy taken by the heat pump	[*J*].

Theoretical coefficient of performance of the heat pump [1-6]:

$$COP = \frac{Q_h}{W} = \frac{Q_c + W}{W} \tag{2}$$

where:

COP	coefficient of performance of the heat pump	[-].

The heat energy stored in the hot water tank of the heat pump as hot water:

$$Q_{\text{tank}} = m_w c_w \Delta T_w \tag{3}$$

where:

Q_{tank}	heat energy stored in a hot water tank	[*J*],
m_w	mass of the heated water	[*kg*],
c_w	specific heat of the water, $(4.2\, kJ/kg^{\circ}C)$	[$kJ/kg^{\circ}C$],
ΔT_w	difference of the mean temperature at the bottom and on the top of the water tank	[$^{\circ}C$].

As a result of the losses of the system:

$$Q_h > Q_{\text{tank}}. \tag{4}$$

The heat loss on the condenser side:

$$Q_{loss} = Q_h - Q_{\text{tank}} \tag{5}$$

where:

Q_{loss} loss generated in the heat exchanger (condenser) [J].

Thus the relation of the actual and theoretical coefficients of performance can be written on the operation of the heat pump, using relation (3):

$$COP > COP_{actual} = \frac{Q_{tank}}{W} = \frac{m_w c_w \Delta T_w}{W}. \tag{6}$$

The heat pump system is a cycle that consists of two heat exchangers (evaporator, condenser), a compressor and a butterfly valve [7]. Each element is joined by a pipe filled with transfer medium. The operation of the heat pump is illustrated in Figure 2.

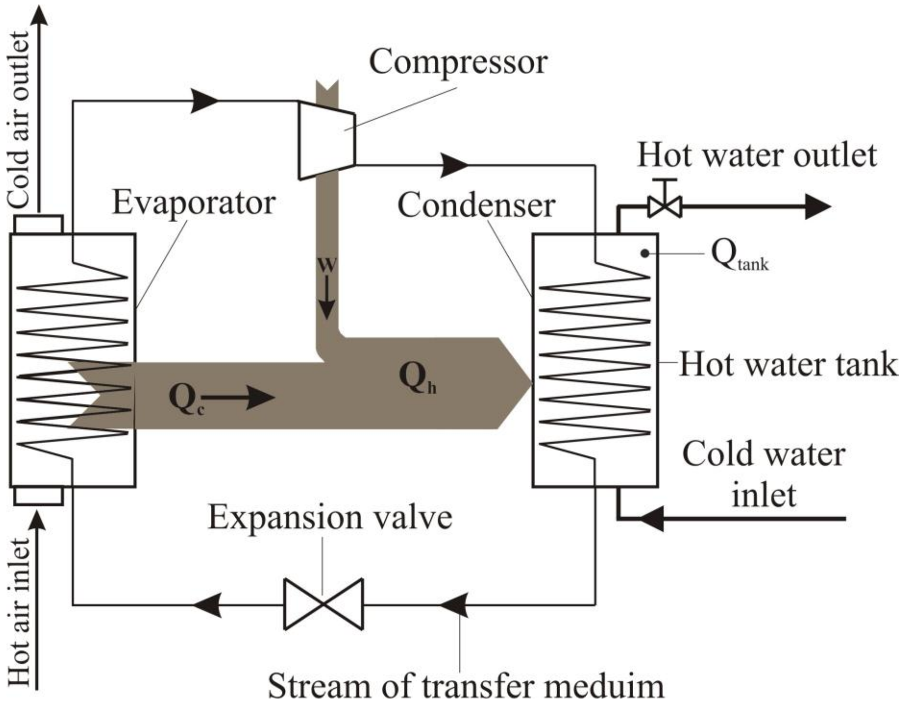

Figure 2 Working process of the heat pump cycle

1 The compressor condenses the gaseous transfer medium (R134a) using electric energy (which heats) and circulates it in the system permanently.

2 The heat of the hot gas inside the fan-coil unit - through a water heat exchanger - is used for making hot water, while the medium cools down, precipitate and turned into fluid again.

3 The liquid medium flows to a space of bigger cross section, through an expansion valve, to the evaporator. The pressure declined hereby makes the medium, which expands and strongly cools accordingly, gaseous again.

4 By utilizing hundreds of cubic meters of air sucked through the evaporator, heat is distracted from the surroundings, which makes the air cool down in the room. Then this hotter vapor is condensed again starting from the first step.

Heat pumps are heat engines of reverse operation. The thermodynamic cycle can be followed on the temperature-entropy (T-s) diagram (Figure 3). The process starts from point 1, where the medium at p_i pressure and T_i temperature occurs as saturated vapor. Processes 1 and 2 are adiabatic compressions that happen in the compressor. Normally, this change of state is indicated in the diagram as a vertical line (isentropic compression), but in reality the change of state is irreversible, entropy permanently increases, thus the curve slightly bends to the right. Processes 2 to 5 happen in the condenser: processes 2 and 3 are the distraction of overheating heat; in point 3 the vapor reaches saturated state at pressure p_f . In processes 3 and 4 the temperature does not change, more and more vapor precipitates and the liquid state emerges in point 4. Processes 4 and 5 in the condenser is the possible after-cooling of the fluid medium, then processes 5 and 6 is the thermodynamic process, which results in sudden fall of the pressure, at the end of which the medium expands to p_f pressure and T_f temperature, the liquid partly (approximately half of it) evaporates suddenly and the medium turns into wet, vapor state. This is an isenthalpic process, i.e. during the process the enthalpy does not change. Finally, in processes 6-1, the medium takes heat in the evaporator from the space to cool at permanent temperature and pressure, while the moisture content of the vapor declines gradually. Then the medium returns to the starting point of the cycle, to state 1, and the process starts again. Naturally, all mentioned above apply to an ideal medium; the processes rather differ in deed [10].

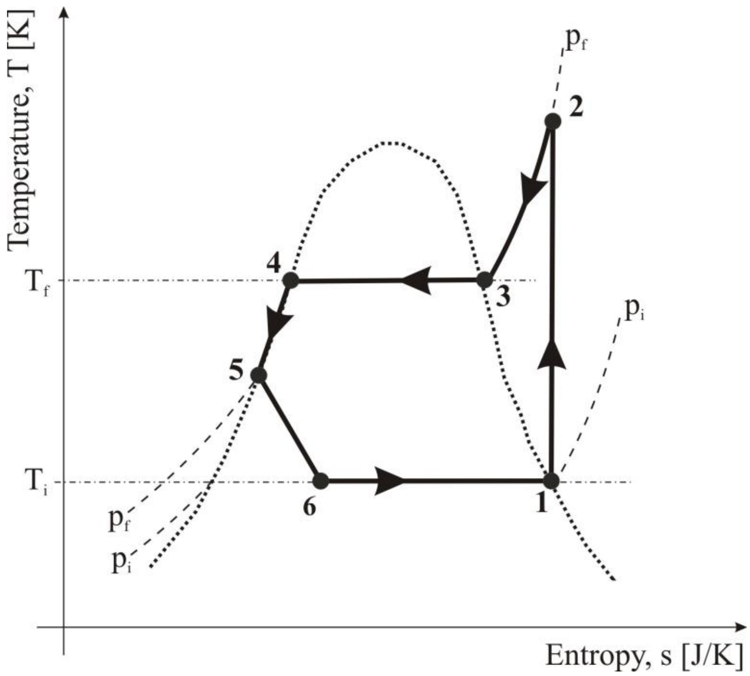

Figure 3 Cycle of the vapor-compression refrigerator on the temperature-entropy diagram

Measuring system and measuring method

A heat pump installed in one of the rooms of the site of Óbuda University in Doberdó Street is examined focusing on the economy of air-conditioning. The examination is performed depending on the measuring order illustrated on Figure 4.

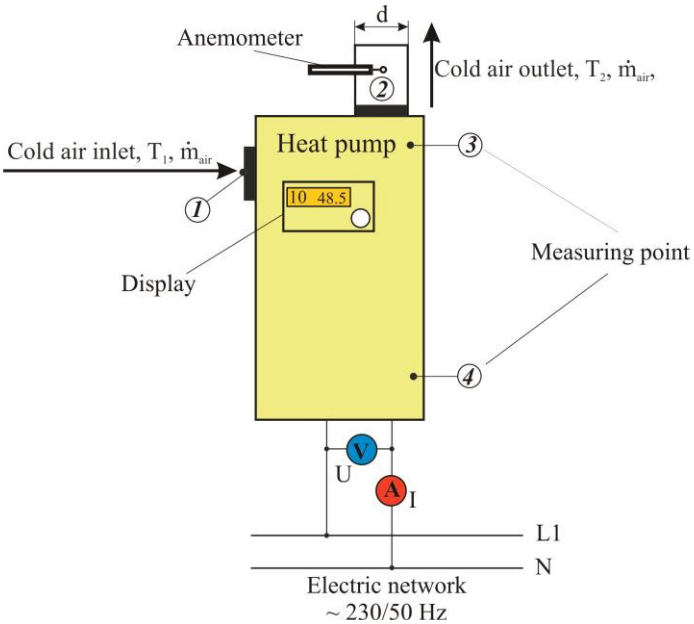

Figure 4 Measuring order of a heat pump

The measuring system consists of the following main elements:

- air-water heat pump to examine,
- anemometer type testo 435,
- ammeter and voltmeter,
- thermometers built in the heat pump.

Measuring and results

The temperatures of the air let in and out of the pump are measured at the measuring points 1 and 2 as illustrated on Figure 4. At point 2 the air flows out of the pump through a pipe end of 160 mm diameter. The speed of the air let out of the pump is measured with an anemometer type testo 435, the average of which is: $v_{air} = 3.3\, ms^{-1}$. During the time of warming up ($t = 242 \min \approx 4\, h$) the volume flow rate of the air blown out is 237,6 m^3/h. The outcoming values relating to the measuring time are illustrated in Microsoft Excel. Afterwards, the trend lines are defined by using regression, indicating the determinant coefficients R^2.

Table I
Temperature measuring results

Measuring time, t [min]	Inlet air temperature, $T_1\,[^\circ C]$	Outlet air temperature, $T_2\,[^\circ C]$	Hot water temperature up, $T_3\,[^\circ C]$	Hot water temperature down, $T_4\,[^\circ C]$
0	24.2	22.5	26.9	26.4
5	24.2	17	27	26.4
10	23.5	13.2	27.6	26.4
15	23.1	12.5	28.2	26.4
30	22.6	12.1	30	26.4
45	22.5	11.4	31.6	26.5
60	22.4	11.1	33.2	26.5
75	22.3	10.9	34.7	26.6
105	22.2	10.9	37.5	26.7
135	22.2	11.1	40.3	27
165	22	11.1	43.1	27.4
195	21.8	11.2	45.8	27.9
225	21.7	11.3	48.5	28.5
242	21.7	11.2	50	29.8

Figures 5 and 6 illustrate the inlet and outlet temperatures of air listed in Table I.

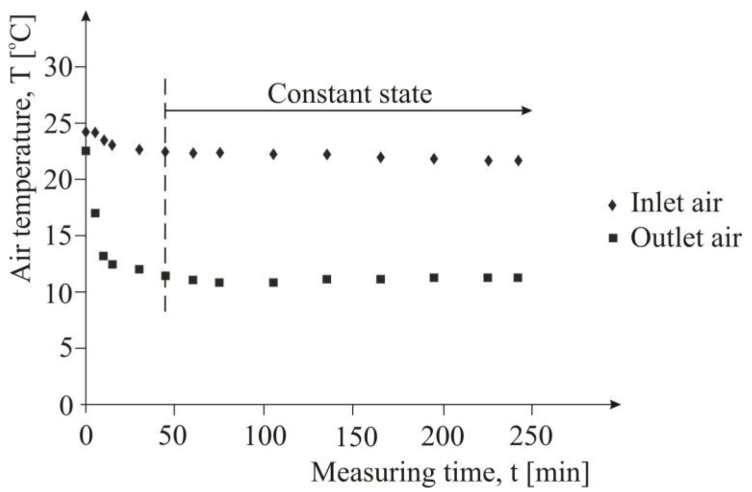

Figure 5 The temperatures of inlet and outlet air during the operation of the heat pump

Figure 6 indicates the regressive approach of the air let in and out, also marking the determinant coefficients.

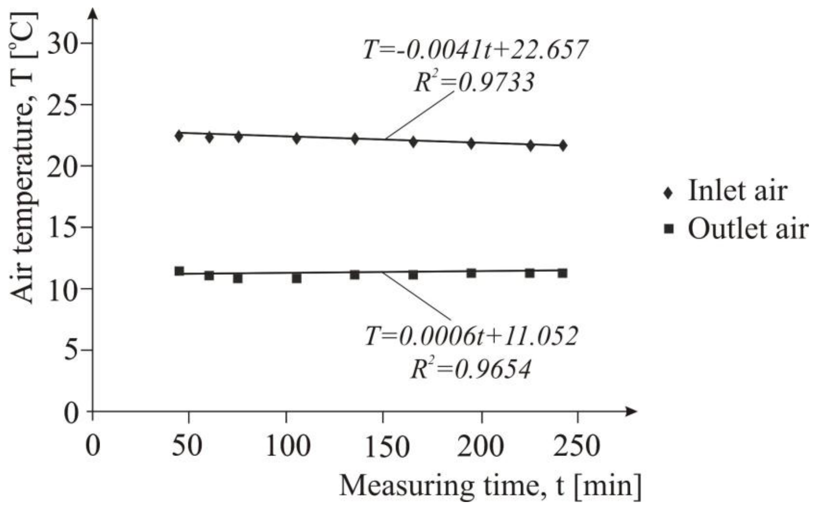

Figure 6 The temperatures and regression of inlet and outlet air in the constant state

At measuring point 3 in Figure 4, the temperature is measured at the top of the hot water tank, and at point 4, the temperature is measured at the bottom of the tank. Table I contains the measuring results. Figure 7 shows the temperatures of the hot water tank.

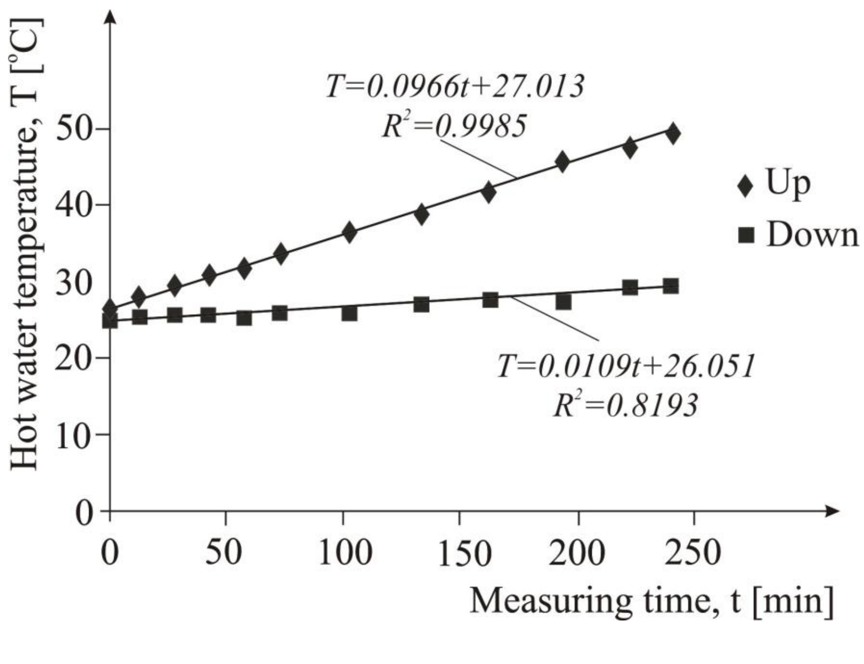

Figure 7 The temperatures of the hot water tank up and down

Figure 8 indicates the temperatures of the evaporator.

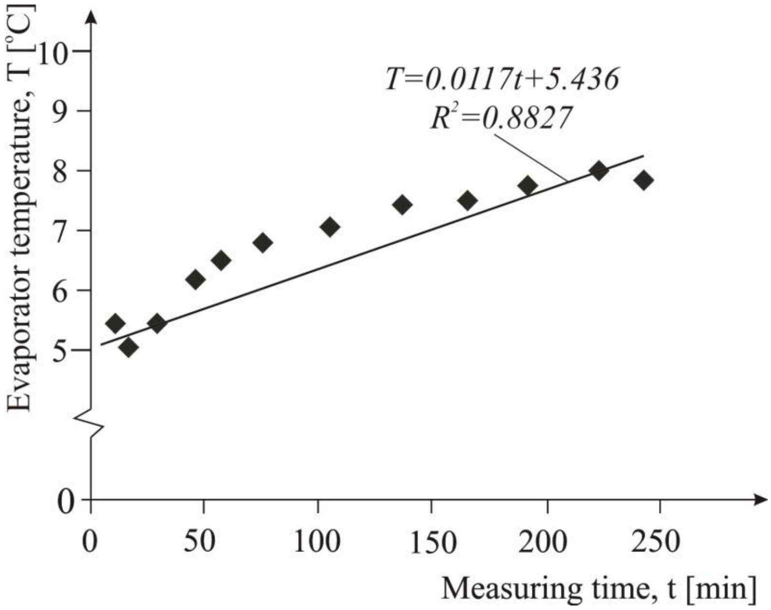

Figure 8 Temperature ranges of the evaporator

Figure 9 presents the current consumption of the heat pump with constantly $U = 224V$ alternating voltage; the graph indicates increasing current consumption. The value of the power factor during the operation of the heat pump is $\cos\varphi = 0.9$.

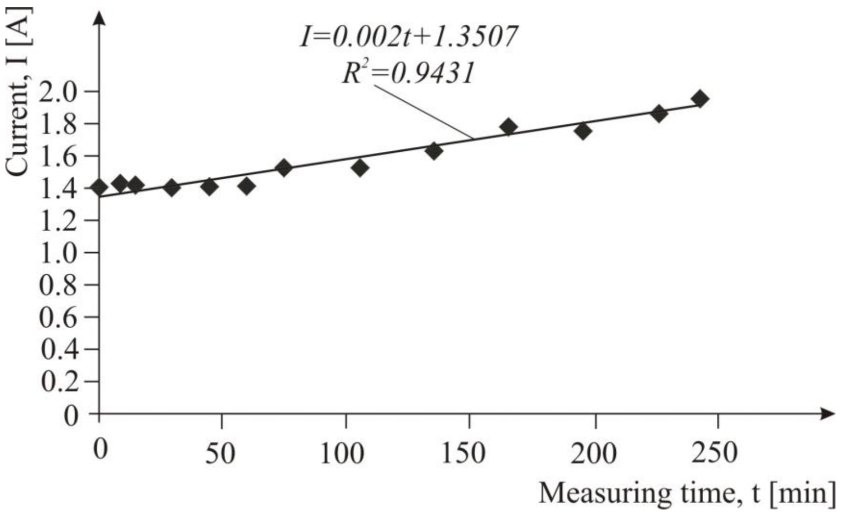

Figure 9 Current consumption of the heat pump

Rewriting relation (6) to performances:

$$COP_{actual} = \frac{Q_{\text{tank}}}{W} = \frac{P_{\text{tank}} \cdot t}{P_e \cdot t} = \frac{P_{\text{tank}}}{P_e} \tag{7}$$

where

P_{tank}	heat power of the hot water tank	[*kW*],
P_e	electric power taken by the heat pump	[*kW*].

Taken electric power based on the measured data:

$$P_e = U\bar{I}\cos\varphi = 224 \cdot 1.53 \cdot 0.9 = 308.5\,W \approx 0.3\,kW. \tag{8}$$

where

U	effective value of the alternating voltage	[*V*],
$\bar{I}$	average of the measured currents (based on the data of Figure 9)	[*A*].

Volume flow rate of the inlet and outlet air:

$$\dot{V}_{air} = A\bar{v}_{air} = \frac{d^2\pi}{4}\bar{v}_{air} = \frac{0.16^2\pi}{2}3.3 = 0.02 \cdot 3.3 = 0.066\,m^3/s = 237.6\,m^3/h. \tag{9}$$

where:

A	cross section of the and air pipe end in and out	[m^2],
d	diameter of the air pipe end in and out (Figure 4)	[*m*],
$\bar{v}_{air}$	average speed of the air outlet in the cross section out	[m/s].

The mass flow of the inlet air:

$$\dot{m}_{air} = \dot{V}_{air}\rho_{air} = 0.066 \cdot 1.2 = 0.0792 \approx 0.08\,kg/s = 288\,kg/h. \tag{10}$$

where:

ρ_{air}	density of the air ($\rho_{air} = 1.2$ kg/m^3)	[kg/m^3].

Heat power extracted from the air:

$$\dot{Q}_c = \dot{Q}_{air} = \dot{m}_{air}c_{air}\Delta T_{air} = \dot{m}_{air} \cdot c_{air}\left(\bar{T}_1 - \bar{T}_2\right) = 0.08 \cdot 1 \cdot (22.6 - 11) = 0.928 \approx 0.93\,kW. \tag{11}$$

where

c_{air}	specific heat of the air at constant pressure ($c_{air} \approx 1\,kJ/kg^\circ C$)	[$kJ/kg^\circ C$],
ΔT_{air}	difference of the mean temperatures of the inlet and outlet air	[$^\circ C$].

Quantity of the heat of the hot water based on (3) and Figure 10:

$$Q_{\text{tank}} = m_w c_w \Delta T_w = m_w c_w\left(\bar{T}_{34i} - \bar{T}_{34f}\right) = 290 \cdot 4.2(40.0 - 26.65) = 16260.3\,\text{kJ} \approx 16.26\,MJ. \tag{12}$$

where

$\bar{T}_{34i}$	the mean temperature of the water tank at the beginning of measuring (Fig. 10)	[$^\circ C$],
$\bar{T}_{34f}$	the mean temperature of the water tank at the end of measuring (Fig. 10)	[$^\circ C$].

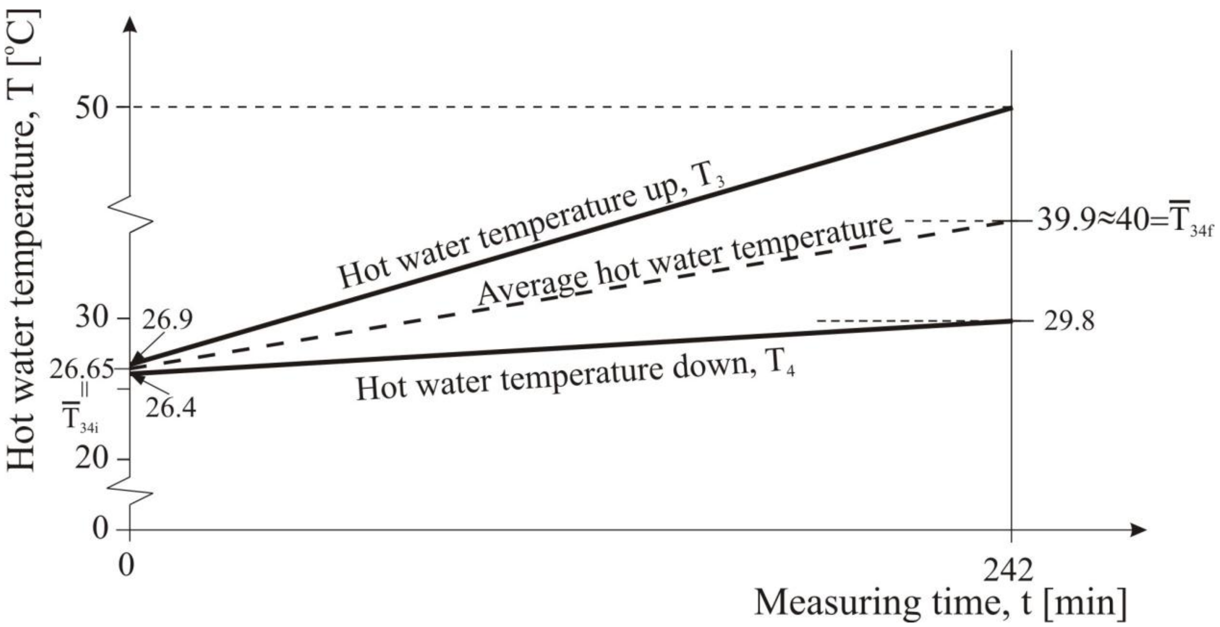

Figure 10 Temperature ranges of the hot water tank depending on measuring time

Heat power:

$$P_{\text{tank}} = \dot{Q}_{\text{tank}} = \frac{Q_{\text{tank}}}{t} = \frac{16.26 \cdot 10^6}{14.52 \cdot 10^3} = 1.119 \approx 1.12\, kW. \tag{13}$$

where

t	measuring time (warming up time)	[s].

Applying this factor the result is relation (7), i.e. the actual coefficient of performance of the heat pump:

$$COP_{actual} = \frac{P_{\text{tank}}}{P_e} = \frac{1.12}{0.3} = 3.73 \approx 3.7. \tag{14}$$

CONCLUSION

The value of the coefficient of performance, while examining the heat pump energetically, is $COP = 3.7$, which corresponds to the value defined in the technical literature. At present, concerning air intake air conditioners, the heat energy taken from the space to air-condition is generally let outside the room. In our research a system is established that enables the heat energy that has been managed as loss so far, to be utilized for making domestic hot water. This energy decreases the amount of electricity taken for making domestic hot water. Thus the efficiency of the system (air-conditioning and making domestic hot water), having been examined, is nearly 100%. The time of the static return of investment of the system may be defined by the following relation [9].

$$\text{Time of return of investment} = \frac{\text{Invested sum of money}}{\text{Savings annually}}. \tag{15}$$

Return of investment of this system may be expected within 5 years.

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IMPACT OF OLD ENVIRONMENTAL LOADS TO THE SELECTED ENVIRONMENTAL COMPONENTS

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Abstract: *Due to recent rapid technological development and population increase, water resources such as surface water are in danger of severe pollution. Large areas in Slovakia are polluted by heavy metals as the result of long-time mining or subsequent ore - processing activities. The aim of the study was to determine the content of heavy metals (Cu, As, Pb, Fe, Hg) in Rudnansky creek, which flows through the environmentally loaded and unhealthy former mining area and describe the flora diversity along the creek. Some chemical (pH) and physical (water conductivity, oxygen saturation) water properties were also evaluated. Above the limit values of copper and mercury were determined on the localities close to the tailing pond and mercury processing plant as the result of insufficient security. Plant species composition indicates the presence of toxic elements, what result in the occurrence of the species resistant for heavy metals as:* ***Calamagrostis epigejos, Arctium lappa,*** *Cirsium rivulare,* ***Geranium palustre.***

Keywords: *heavy metals, old environmental loads, flora diversity*

INTRODUCTION

Anthropogenic surface water contamination is generally ascribed to municipal and industrial wastes, extreme use of agricultural fertilizers and mining or subsequent processing activities. Heavy anthropogenic pollution severely impairs the water environment. Middle Spis represent former mining area, which is due to inefficient security heavily polluted by heavy metals, especially by mercury and copper, which were long-time mining and processing there. Heavy metals are natural components of soil, rock, air, water and living organisms [1], [2], but because of their extensively using in the human society, was their natural balance disrupted.

The Rudnany village, one of the biggest mercury ore deposits in Slovakia, more than the 700 years participates to the production of huge amount of mercury. According to the [3], 42 million tons of mercury and copper ores were mined there. Mining and the ore processing caused the changes of geological land structure, contamination of all environmental components and other mining forms. In 1993 due to low prices, low demand and increasing environmental concerns, the mines were gradually abandoned. Numerous abandoned mines, heaps of waste material and drainage waters become the main source of undesirable substances, predominantly heavy metals, which may pose a serious and continuing health risk to humans and environment [4].

Toxicity of heavy metals is also reflected on the specific vegetation growing along the creek. Mining heaps are habitats with specific ecological conditions for plants. The plants which are

very sensitive to the heavy metals [5] resulting in disorders of stomata, suppression of photosynthesis, respiration disrupted, reduced growth or death. Because of very high content of heavy metals and the substrate toxicity, only some plant species are able to survive there. There is a group of plants, which are able to create the special strategy or use different mechanisms which allow them to survive the inhospitable conditions [6].
The plant species that have the ability of hyperaccumulation of heavy metals and thus perform their elimination from the environment must satisfy basic conditions [7] as tolerance of higher concentrations of heavy metals in leaf and root, ability to transfer ions of heavy metals and other elements from the root to the leaf and specific observation of heavy metals in relation to soil and plant.
The aim of the study was to determine the heavy metal (Cu, As, Pb, Fe, Hg) content in the five sampling points of Rudnansky creek depending on the presence of the mercury processing plant and the tailing pond and evaluate the influence of heavy metals to the selected chemical and physical water properties. We also evaluate the flora diversity and occurrence frequency of plant species along the Rudniansky creek.

EXPERIMENTAL

The research was conducted in 2011 in the Rudňany village [48°53'870"E; 20°39'960"N] which, as the former mining area, was included to the environmentally loaded and unhealthy areas in Slovakia. Long-time mining and the processing of mercury and copper ores caused the serious environmental problems, predominantly heavy metal pollution of the environmental components.
For the research investigation Rudnansky creek flowing through the Rudnany village was selected. Collection and water treatment was performed using the methodological guidelines of the Ministry of Environment of the Slovak Republic [8]. Sampling points were deployed in the downstream direction (1 to 5) (Figure 1). Water samples were processed immediately after sampling in the accredited laboratory. Heavy metal content (Cu, As, Pb, Fe, Hg) was determined by AAS (atomic absorption spectrometry) and AAS-ICP (atomic absorption spectrometry with inductively coupled plasma) methods.
All reached heavy metal contents were compared with the limit values for Slovak surface waters [9]. Chemical (pH) and physical (conductivity, oxygen saturation) water properties were determined using multi-analyzer for determination of the physical and chemical water properties. Flora diversity was evaluated according to the Braun – Blanquet´s [10] seven member scale (5- cover of 75- 100%; 4 – cover of 50-75%; 3 cover of 25-50%; 2 cover of 5 – 25%; 1 – cover less than 5%, + - negligible cover, r- occasionally), which describe the frequency and cover of species population. Semi-quantitative analysis of present taxa was performed on an area of 16 m^2. Terminology was used in accordance with Marhold and Hindák [11]. The determination of species diversity was evaluated by Shannon index,

$$H' = -\sum_{i=1}^{s} \frac{x_i}{N} \log_2 \frac{x_i}{N} \quad (12),$$

which is sensitive to the different characteristics of plant communities. The localities were included to the ten categories, depending the diversity index (1 extremely low (H' <0.5); 2 very low (0.5<H' <1); 3. moderately low (1<H' <1.7); 4 low (1.7<H' <2.5); 5 low to moderate (2.5<H' <3.3); 6 medium (3.3<H' <4); 7 moderately high (4<H' <5); 8 high (5<H' <7); 9 very high (7<H' <10); 10 extremely high (H' <10).

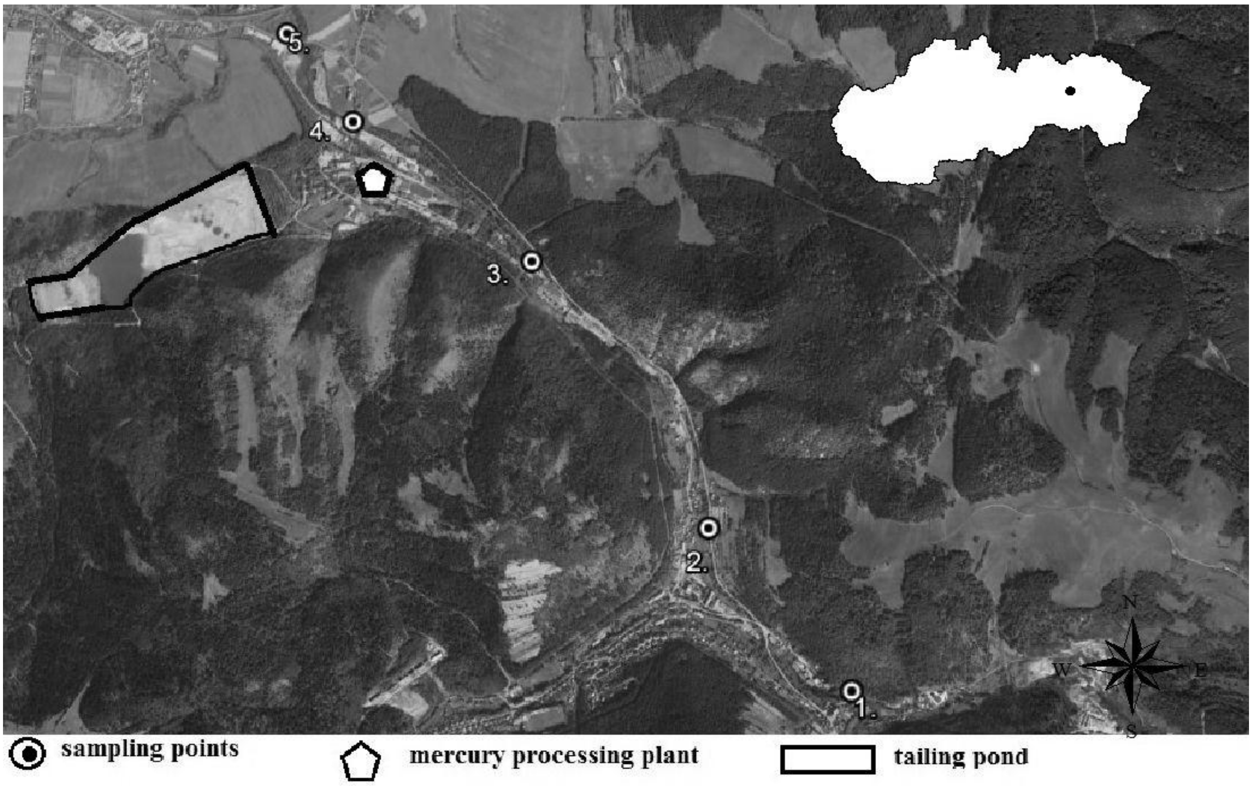

Figure 5: Sampling points of Rudnansky creek

RESULTS

Measured values of heavy metals, limit values of heavy metals and chemical and physical water properties are listed in Table 1. Heavy metal content in the sampling points was changing according to the proximity of the sources of pollution. The highest (23 μg/l) and above the limit value of copper was determined only at one sampling point, which was located close to the tailing pond and near to the processing plant.
The values of mercury reached the limit value (0.1 μg/l) at each sampling points. On the locality 3, 4 and 5 was the limit value of mercury exceeded 3, 4 and 3 times, respectively. The most polluted sampling point was the locality 4 (the same as in the case of copper), which was sampled close to the tailing pond and ore - processing plant. The limit values of arsenic, lead and iron wasn't exceeded.
Values of pH ranged from 7.75 (alkaline) to the 8.86 (strongly alkaline). Correlation relationships between heavy metals and other water properties are listed in Table 2. Heavy metals gave the positive correlation between themselves, what suggest the same source of them. There has been reported significant positive relationship only between copper and iron ($P<0.01$). We also reported significant positive correlation ($P<0.01$) between total content of mercury and the water conductivity.

Table 1 : Heavy metal contents and selected chemical and physical water properties in the Rudnansky creek

Locality	**Cu** [μg/l]	**As** [μg/l]	**Pb** [μg/l]	**Fe** [mg/l]	**Hg** [μg/l]	**pH**	**Conductivity** [μS]	**Oxygen saturation** [%]
1	2	5	5	0.225	0.1	7.75	262	83.7
2	4	4	5	0.098	0.1	8.86	296	101.5
3	6	5	5	0.139	0.3	7.97	628	79.7
4	23	6	5	1.52	0.4	8.32	629	101.9
5	5	5	5	0.09	0.1	8.43	664	97.5
Limit value*	**20**	**20**	**20**	**2**	**0.1**	**-**	-	-

*Act No. 269/2010 Coll. of Laws

Table 2: Correlation relationship between heavy metals each other and heavy metals and chemical an physical water properties measured in Rudnansky creek

	Cu	**As**	**P b**	**Fe**	**Hg**
pH	0.11	-0.44	0.00	-0.06	0.42
Conductivity	0.51	0.62	0.00	0.34	0.94**
Oxygen saturation	0.47	0.01	0.00	0.42	0.18
Cu		0.79	0.00	0.97**	0.77
As			0.00	0.81	0.79
Pb				0.00	0.00
Fe					0.63

** Correlation in significant at the 0.01 level
*Correlation in significant at the 0.05 level

The results of the phytocenological research are listed in Table 3. Flora composition has not changed significantly depending on the locality position. We reported significant occurrence of the species such as *Calamagrostis epigejos, Arctium lappa, Cirsium rivulare***,** *Geranium palustre,* which are considered as species with wide ecological valence and resistance to heavy metal pollution. The species as *Acetosa pratenis*, which was found at locality 4 and 5 usually inhabits for ruderal habitats. In the terms of diversity species, which was determined using Shannon diversity index (Figure 2) there has been reported low diversity at all sampling fields, except the locality 3 and locality 4, where low to moderate diversity was determined.

Table 3: Phytocenological characteristics of plant communities on the sampling point close to the Rudnansky creek

Locality	**The flora composition**	**Shannon H' index**	**Equitability**
1	E_0, E_2, E_3, no species were recorded **E_1**: *Poa pratensis* 1, *Equisetum* 1, *Alchemilla xanthochlora* 1, *Calamagrostis epigejos* 1, *Cirsium rivulare* 1, *Trifolium pratense* +, *Plantago major* +, *Agrostis capillaris*+, *Silene vulgaris* +, *Geranium palustre* +, *Taraxacum officionale* +, *Acetosa pratensis*	2.569	0.9736

	+, *Dryopteris filix-mas* +, *Arctium lappa* r, *Caltha palustris* r, *Alliaria petiolata r,*		
2	E_0, E_2, E_3, no species were recorded **E_1**:*Chrisosplenium alternifolium* 2, *Plantago lanceolata* 1, *Silene vulgaris* 1, *Calamagrostis epigejos* 1, *Arctium lappa* 1, *Arctium tomentosum* + *Agrostis stolonifera* +, *Taraxacum officionale* +, *Cirsium rivulare* +, *Trifolium pratense* +, *Carex acuta* +, *Acetosa pratensis* +, *Salix cinerea* +, *Veronica chamaedrys* +, *Petasites hybridus* +,	2.507	0.865
3	E_0, E_2, E_3, no species were recorded **E_1**:*Arctium tomentosum* 1, *Arctium lappa* +, *Eupatorium cannabinum* +, *Agrostis capillaris*+, *Silene vulgaris* +, *Taraxacum officionale* +, *Alchemilla xanthochlora* +, *Caltha palustris* +, *Acetosa pratensis* +, *Epilobium roseum r, Calamagrostis epigejos* +, *Juncus effusus r, Lychnis flos-cuculi* r	2.369	0.858
4	E_0, E_2, E_3, no species were recorded **E_1**:*Geranium palustre* 1, *Arctium lappa* 1, *Agrostis capillaris* 1, *Calamagrostis epigejos* 1, *Silene vulgaris* +, *Taraxacum officionale* +, *Arctium tomentosum* +,*Carex acuta* + , *Urtica dioica* +, *Alliaria petiolata r, Eriophorum angustifolium r, Dryopteris filix-mas r,* +, *Cirsium rivulare r,*	2.358	0.865
5	E_0, E_2, E_3, no species were recorded **E_1**:*Arctium tomentosum* 1, *Cirsium rivulare* r, *Geranium palustre* +, *Acetosa pratensis* +, *Trifolium pratense* +, *Calamagrostis epigejos* +, *Silene vulgaris* +, *Eupatorium cannabinum* +, *Chrisosplenium alternifolium* +, *Dryopteris filix-mas r,*	2.543	0.857

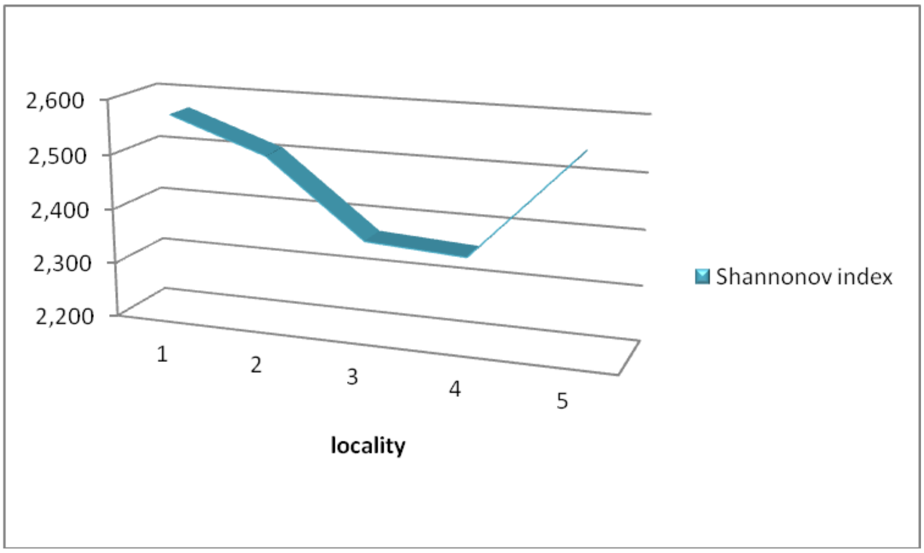

Figure 2: Diversity of the plant species according to the Shannon index

DISCUSSION

Copper and mercury concentrations that occur in some sampling localities of Rudnansky creek are very high and above the permissible limit values. Unfavorable situation is the result of long-term and intense mining activity in the region. Presence of the mercury processing plant and the barite processing plant in the Rudnany village, contribute significantly to the soil and water pollution. Numerous heaps of waste material and tailing ponds, which have been left without proper management in closed metal mines, have become the source of heavy metal contamination in adjacent watercourses [13]. The results show, that the tailing pond localized in Rudnany village is not secure enough and the toxic elements easily penetrate to the water environment, because the highest and above the limit values of copper and mercury were measured on the sampling points close to it. Using Spearman's correlation coefficient, we reported significant positive correlation between content of copper and iron. If there is a significant correlation between elements, there is a high probability they come from the same pollution source [14]. Solid waste from the production of copper, which is concentrate in the heaps of waste material next to the copper processing plant, contains the residues of iron [15], [16], what explain the correlation relationship between these metals. There has been reported repeatedly, that copper and mercury as very toxic and dangerous contamination element lead to the numerous diseases of living organisms [17], [18], [19]. Seepage of contaminants into surface water and groundwater reduces water quality and influence the specific vegetation that grows on the toxic substrate [20]. Especially mining heaps are the habitats with the specific ecological properties. The plants which inhabits this places, must be equipped with mechanisms that allow them to survive the inhospitable conditions [21]. In our case, the plant species with wide ecological valence and resistance to the heavy metal pollution occurred on the sampling localities. As we mentioned above, the occurrence of species that are known to be resistant to heavy metal as *Calamagrostis epigejos, Arctium lappa, Cirsium rivulare*, *Geranium palustre* were reported. The greatest species diversity was found at the first and second locality. Presence of the tailing pond and hence higher content of heavy metals cause a reduction of species and the limit their occurance to the species resistant to heavy metal pollution.

CONCLUSION

The reached data of heavy metal content of Rudnansky creek shows, that the security of tailing pond and other mining waste bodies is insufficient. High and above the limit values of copper and mercury were found at the localities close to the tailing pond and mercury processing plant. Especially mercury exceeds permissible value more than three times at three sampling localities. Because of mercury is a dangerous pollutant and has a negative impact on human health, this information is very disturbing. Using Spearmans correlation coefficient, we found significant positive correlation between copper and iron, what could be the sign of the same source of these metals. The iron is very often produced as accompanying material in the production of copper. Environment contamination was reflected in the species diversity. The study localities were covered predominantly by species with wide ecological valence and resistant to toxic element. In general the diversity of species at all sampling localities reached low or low to moderate values, but the most polluted localities (close to the tailing pond and processing plant) were characterized by lower species diversity. We reported frequently occurrence of the species: *Calamagrostis epigejos, Arctium lappa, Cirsium rivulare*, *Geranium palustre*.

Acknowledgements

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Modification of sun collectors slop direction

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Abstract: *In order to efficiently solve the problems created by the deepening energy crisis affecting Europe and the world, governments cannot neglect the opportunities of using the energy produced by sun collectors. In many of the EU countries there are sun collectors producing heat energy, e.g. in Austria more than 3,500,000m² and in Germany more than 12,000,000m² of sun collectors are operated [5]. The energy produced by these sun collectors is utilized at the place of production. In the near future governments will have to focus more on spreading and using sun collectors. Among the complex problems of operating sun collectors, this article deals with determining the optimal slop angle of sun collectors. The slop angles which we determined theoretically are confirmed by laboratory measurements. The result of our work will help users and engineers to determine the optimal operation of sun collectors.*

Keywords: *sun collector, heat energy, optimal slop angle*

Sun-Earth geometry

In order that the surface of the sun collectors should be able to convert as much as possible from the energy transported by the arriving sun rays we must be familiar with the Sun-Earth movements. When determining the geometry of the Sun-Earth movement we tried to use the simplest formulas possible that engineers and enterprises designing the sun collectors may be able to work with. From the different types of solar radiation discussed in the previous chapter we would like to deal with direct radiation only. Figure 1 shows the geometric relationships of sun collectors placed on the Earth's surface.

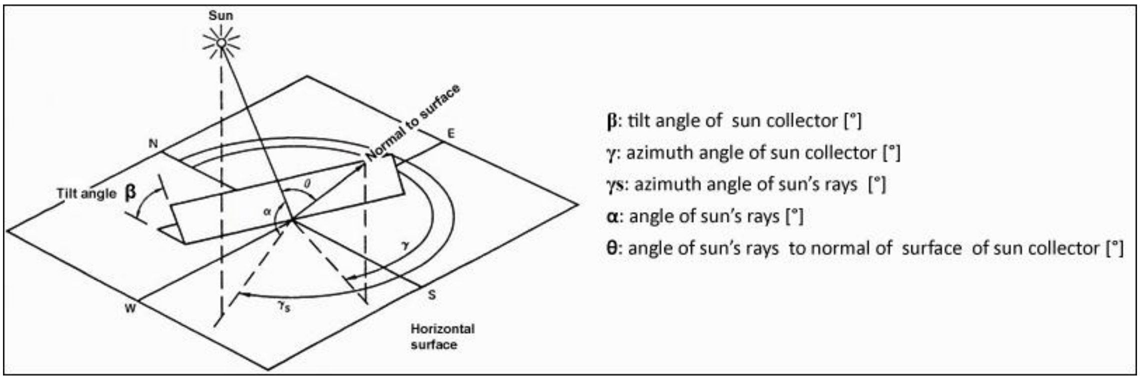

Fig 1. Relationships of the incident beam radiation and a sloped surface [1]

Figure 2 shows the position of direct radiation arriving at the surface of the Earth as a result of the relative position of the Sun and the Earth.

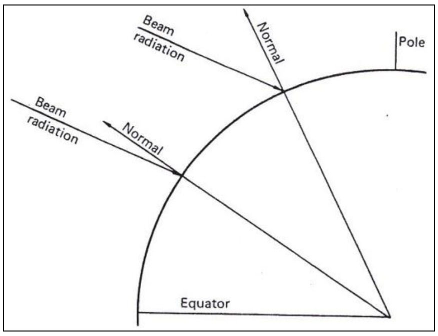

Fig 2 Effect of latitude on sun angle [1]

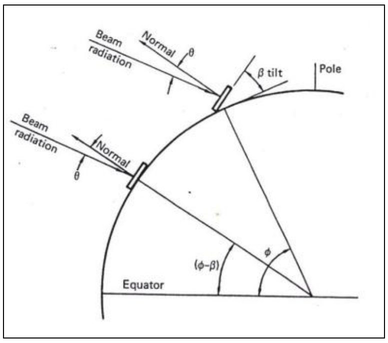

Fig 3 Effect of collector slop

If we place a sun collector at a slop angle β, the geometry of the rays reaching the surface is shown in Figure 3. This figure also shows the central angle (Φ) which belongs to the northern latitude.
A collector sloped south at an angle β at a latitude Φ has the same sun angle as a horizontal collector at latitude (Φ - β) [1]. The amount and intensity of the radiation arriving at the surface of the sun collector also depend on the relative position and movement of the Earth-Sun. Figure 4 depicts the movement of the Sun and Earth in relation to each other, the so-called sun paths at 48˚ north longitude.

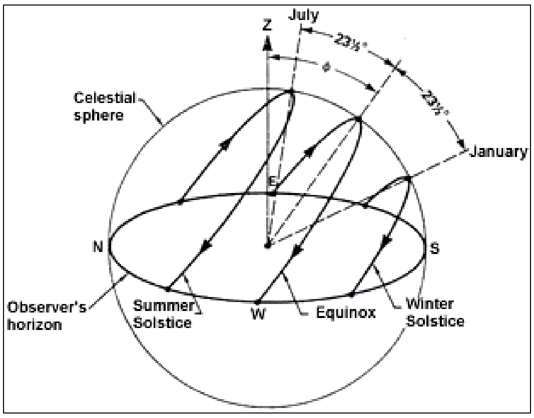

Fig 4 Visualization of the sun paths across the sky [1]

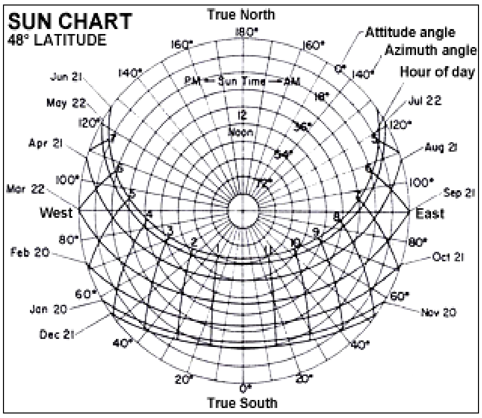

Fig 5 Sun charts [1]

At 48˚ latitude of the northern hemisphere the figure shows the sun's movement at the time of the winter and summer solstice and the equinox. If we prepare the top-view picture of this figure, we get the sun chart of this northern latitude (Figure 5). According to the sun charts the sun gets the closest to the sun collector placed in the centre of the figure i.e. the observation point, at the time of the summer solstice, i.e. at 12.00 June 21st. It is obvious from this figure that if the sun collector is directed in the true south direction, it gets the largest possible radiation energy. During the day the angle of the sun to the normal of the sun collector (θ) changes according to the passage of time. If we want the sun to reach the surface of the sun collector at the most optimal angle during the day, continuous east-west sun collector adjustment must be provided. This topic is not dealt with in this work. In our work with change slop angle β to the horizontal surface and we determine those slop angles (β) at which, during the year, the collector will be capable of transforming the largest energy deriving from the sun. This means that he slop angle of the (β) should be modified according to the movement of the sun each day of the year.

This is technically unimaginable and impracticable; therefore in this section of our article we determine the most optimal slop angle values at the tested geographical location (N 47.5°):

- for the whole year

(the slop angle of the collector (β_{year}) is not modified during the year),

- seasonally

(the slop angle of the collector is modified according to the four seasons. Therefore four slop angles will be defined (β_{summer}, β_{winter}, β_{autumn}, β_{spring})).

The Earth orbits the Sun in an elliptical orbit with an eccentricity of 3%. The Earth makes a full circle in a year. The Earth does not only go around the Sun but it also rotates around its own axis at a speed of one rotation per day. Its own axis is sloped at δ=23.5° from the axis of the orbit around the Sun. In this way during its orbit around the Sun, the northern hemisphere gets closer to the Sun in the summer than the southern hemisphere, and this is changed in winter. In spring and autumn the sloping of the Earth's axis (δ) is such that the distance of the northern hemisphere and the southern hemisphere relative to the Sun is the same. This is shown in Figure 6.

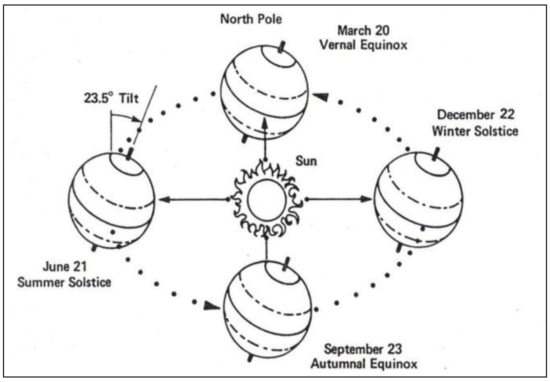

Fig 6 Diagram of the Earth's orbit around Sun

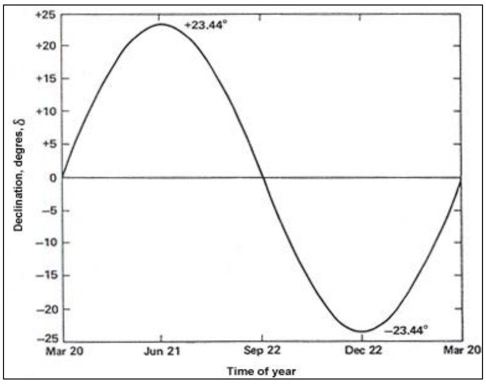

Fig 7 Yearly variation the Sun [1] of the the solar declination [1]

Figure 7 shows the variation derived from the relative declination of the Earth's axis angle (δ) in relation to the time of year.

This variation gives a sinusoidal function which shows that on March 20th and September 22nd, i.e. at the time of the summer and winter solstice the incremental distance between the Earth's northern hemisphere and the Sun is zero, while it is the smallest on June 21st and the largest on December 22nd.

On the basis of our theoretical considerations and experience we have accepted that – globally, regarding a whole year – the slop angle of the sun collector equals the value of the northern latitude, i.e.:

$$\beta_{year} = \phi$$

so at the test site, in Budapest, (47.5° N):

β_{year}=47.5°
According to [1] β_{year}= ϕ should be modified in the following way:
β_{year}= ϕ + (10°÷20°)
We disregard this assumption, proposal during our tests.
The – theoretical – values of seasonal slop angles are the following according to Figure 6.
$\beta_{summer} = \phi - \delta$
$\beta_{winter} = \phi + \delta$
$\beta_{autumn} = \phi$
$\beta_{spring} = \phi$
The slop angles of the sun collectors at the test site, in Budapest, (47.5°N):
β_{summer} = 24°
β_{winter} = 71°
β_{autumn} = 47.5°
β_{spring} = 47.5°
We made some measurements in order to verify the correctness of the values.

1. Laboratory measurements

We made a series of measurements with glass covered flat collectors in order to determine the ideal collector slop angles (β) in the area of Budapest (47.5°N). The main point of the measurement is to determine the optimal slop angles (β) as a result of comparative series of measurements. We measured the thermal characteristics of two sun collectors parallel, at the same time. We had set the slop angle of one collector to a value – which we defined – relating to the whole year (β_{year}) and we did not change that during the series of measurements. This collector was later marked collector B.
The slop angle of the other collector marked A was modified according to the seasonal values defined by us (β_{summer}, β_{winter}, β_{autumn}, β_{spring}) during the measurements. Figure 8 depicts the collectors.

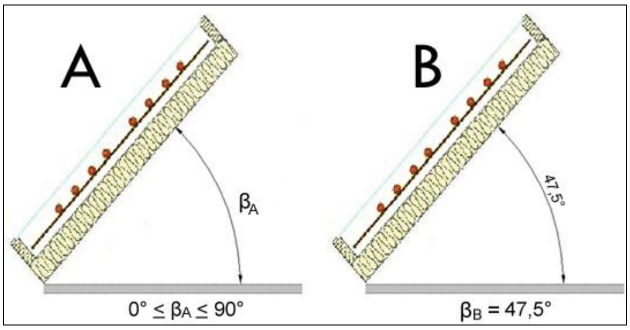

Fig 8 Slop angles of collectors

During the measurements the thermal characteristics of both collectors were measured and we made our conclusions by comparing these. The measurements were made in the summer, autumn and winter of 2011. In our opinion the autumn and spring measurements –

relative to each other – must produce the same result, so we did not make any measurements in spring. This conclusion is supported by Figure 6 as well.

1.1. Description of the measuring equipment

In order to confirm and support by experiments the sun collector slop angles (β) determined theoretically in the previous sections, a special measurement station was created at Óbuda University (Hungary, Budapest) and installed on the roof of the building. With the measurement equipment – which is fully automated and controlled by a computer – we were able to continuously measure the thermal characteristics of the sun collector in summer, autumn and winter. The conceptual layout of the measuring equipment is shown in Figure 9.
The equipment incorporates two (1.6 m^2) glass covered flat collectors (marked A and B) witch were developed by us. The system has two loops. The primary loop which consists of the sun collector and the liquid heat exchanger placed in the solar tank is filled up with antifreeze liquid medium. The secondary loop utilizes the heat content of the water in the solar tank. Measurement points were established in the measuring equipment to measure the water and liquid material temperature, and the mass flow of water and liquids. In order to increase the safety and reliability of the measurements, we measured the amounts by MBUS and PLC systems. The measurements were processed by a monitoring computer and presented them on the screen by VISION system. During the measurements great care was taken to make sure the temperatures and mass flows of the medium entering the collectors – in the case of both collectors – should be equal. This was ensured by keeping the secondary loops and the tank temperatures at a constant value. The characteristics of the external atmosphere were measured by a meteorological station located on the roof and equipment measuring solar radiation, and the results were entered into the monitoring computer. Special care had to be taken of the winter measurements. The system had to be protected against freezing in a way that by the beginning of the – daily – measurement the temperature of the solar tank should not be higher than 2÷3°C. The conceptual layout of the measuring equipment is shown in Figure 9.

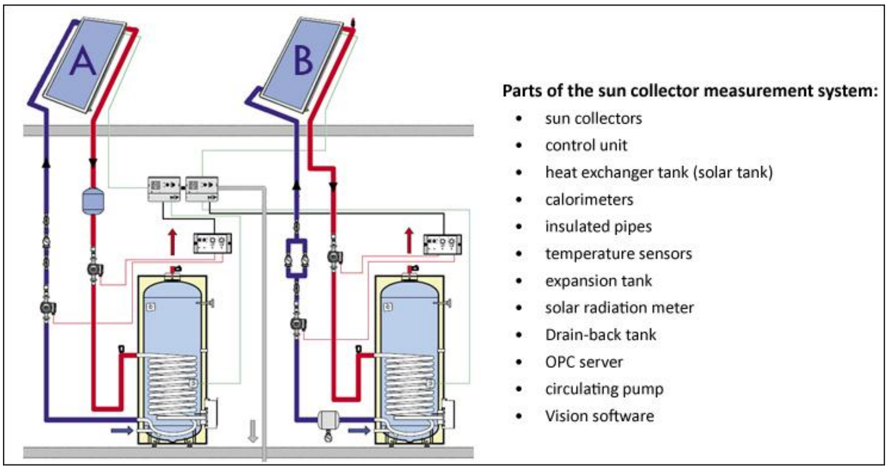

Fig 9 Sun collector measurement system

1.2. Measurements

We set the slop angle of collector B to β_{year}=47.5° and kept it at the same angle during the measurements. We set the slop angle of collector A to three values in each season. These values are the seasonal values which we determined, i.e.:

β_{summer} = 24°
β_{winter} = 71°
β_{autumn} = 47.5°

During the measurements we measured the temperature and the mass flow of the liquids entering and leaving the sun collectors, the temperature of the solar tank, the amounts of heat carried off the solar tank as well as the data of the external atmosphere and solar radiation. During the measurements it was ensured that the temperatures and mass flows of the medium entering the collectors should be equal (T_{inA}= T_{inB}).

When evaluating the measurement results it is sufficient to compare the temperatures of the medium leaving the sun collectors (T_{outA}, T_{outB}). T_{outA}, T_{inA} are the temperatures of the medium exiting collector A, and T_{outB}, T_{inB} are the temperature of the medium exiting collector B. We made conclusions by comparing the exit temperatures. The computer system recorded all the measurement results in diagrams and tables. Figure 10- Figure 18 show the – typical – results of the measurements made in the different seasons in diagrams. The exit temperatures of the sun collectors (T_{outA}, T_{outB} i.e. T_{out}) are plotted as the vertical axis, and the measurement time of the measurement results recorded on the measurement day is plotted as the horizontal axis. The descriptions of the diagrams contain the tested slop angles of the two collectors as: β_B/β_A.

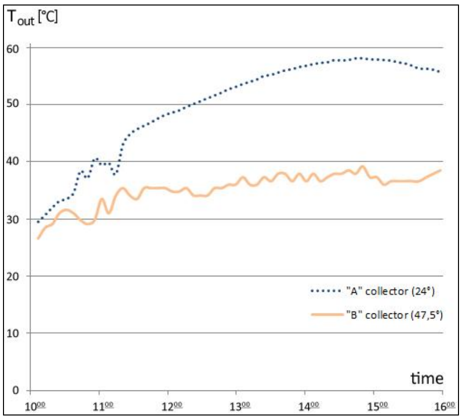

Fig 10 Summer 47.5°/24°

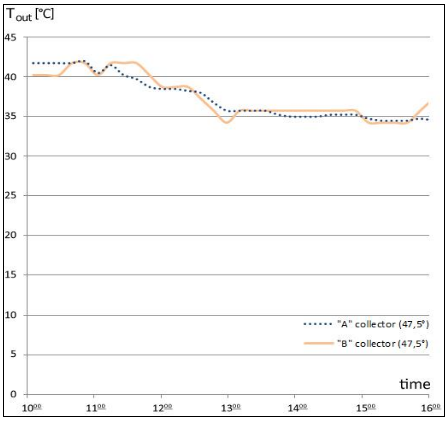

Fig 11 Summer 47.5°/47°

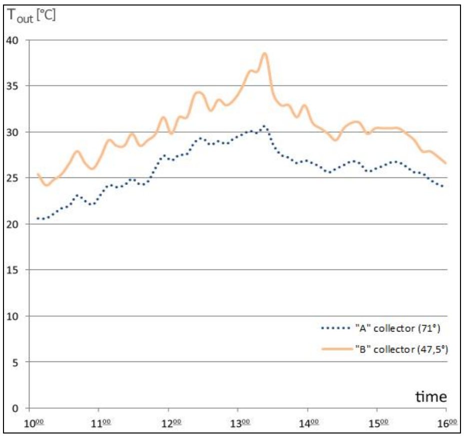

Fig 12 Summer 47.5°/71°

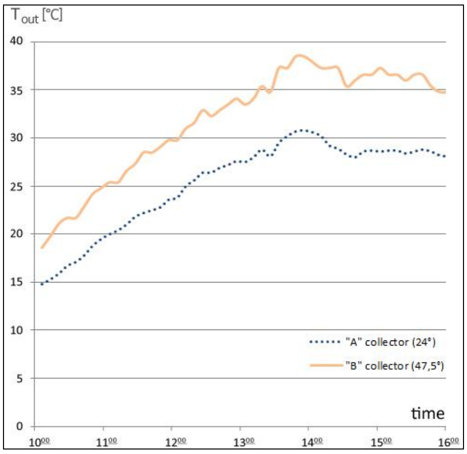

Fig 13 Autumn 47.5°/24°

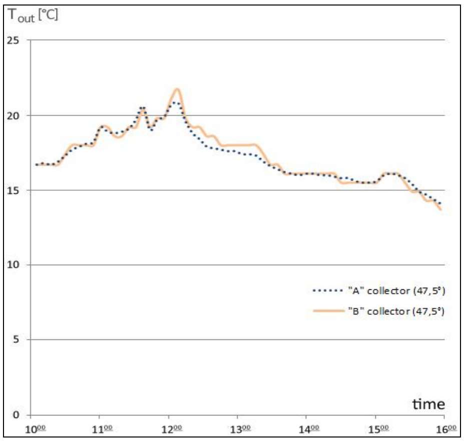

Fig 14 Autumn 47.5°/47.5°

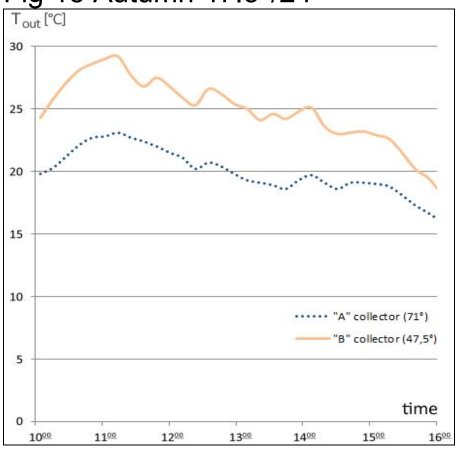

Fig 15 Autumn 47.5°/71°

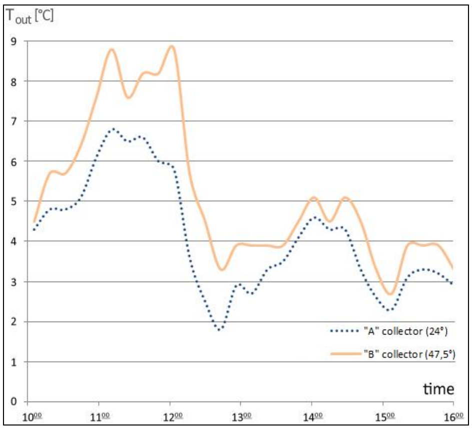

Fig 16 Winter 47.5°/24°

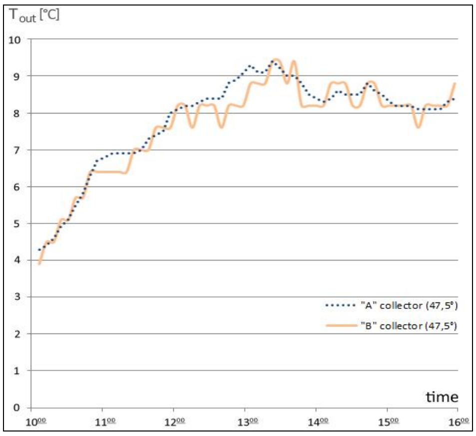

Fig 17 Winter 47.5°/47.5°

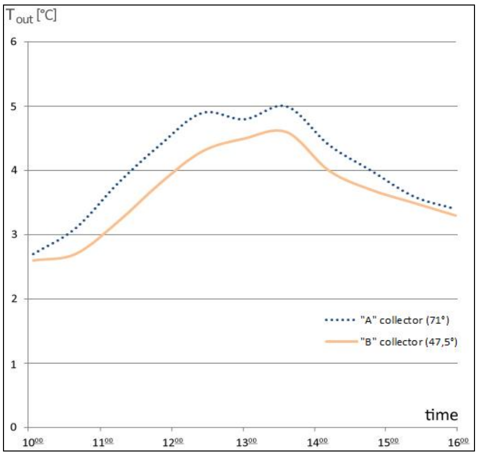

Fig 18 Winter 47.5°/71°

1.3. Evaluation of measurement results

According to the previous chapters the value of entry temperatures of both sun collectors and the value of mass flows of the medium flowing through the collectors were the same during the measurements. In such cases if we want to compare the power of the collectors (P_A, P_B), it is sufficient to compare the temperatures of the medium leaving the sun collector (T_{outA}, T_{outB}) and after this, approximately:

$$\frac{P_A}{P_B} \approx \frac{T_{outA}}{T_{outB}} \qquad (1)$$

For each of Figure 10 - Figure 18 we determined the average values of the relation of the exit temperatures ($R_{TA/TB}$) with the relevant deviations. The relation of averages were determined with the below equation:

$$R_{T_A/\ T_B} = \frac{\sum_{i=1}^{n} \frac{T_{Ai}}{T_{Bi}}}{n} x100[\%] \qquad (2)$$

where $T_A = T_{outA}$, $T_B = T_{outB}$.

If the above described conditions exist, the power relation ($R_{PA/PB}$) of the two tested collectors should – approximately - equal the relations of the exit temperatures of the collectors that is:

$$R_{PA/PB} \approx R_{TA/TB} \qquad (3)$$

The determined power relations slop angle β_A of collector A (with modified slop angle) and the deviation of the calculated temperature relations – according to the seasons – were given in Table 1.-Table 3.

Table 1. Summer, β_B= 47.5°

β_A [°]	$R_{PA/PB}$ [%]	Deviation
24	141	7,23
47,5	100	2,59
71	86	2,46

Table 2. Autumn, βB= 47.5°

β_A [°]	R $_{PA/PB}$ [%]	Deviation
24	80	1,55
47,5	100	1,83
71	81	3,37

Table 3. Winter, βB= 47.5°

β_A [°]	R $_{PA/PB}$ [%]	Deviation
24	80	5,54
47,5	102	4,12
71	110	5,49

Figure 19 – Figure 21 were plotted from Figure 10 – Figure 18 and Table 1 – Table 3.These diagrams shows – approximately – the R PA/ PB change of the power relation of collectors A and B at angles β_A and β_B=47.5°=constant value per season.

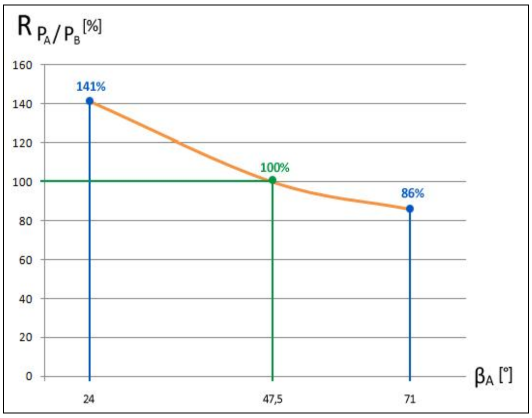

Fig 19 Power relations of collectors in summer, β_B= 47.5°

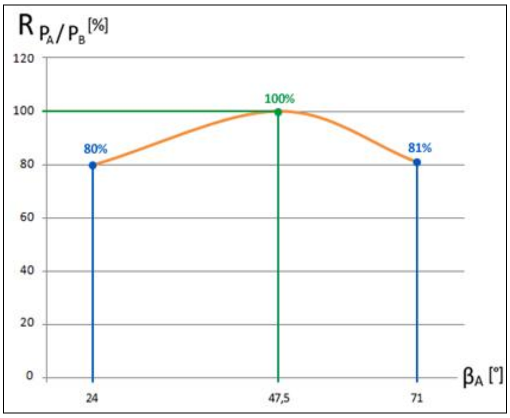

Fig 20 Power relations of collectors in autumn, βB= 47.5°

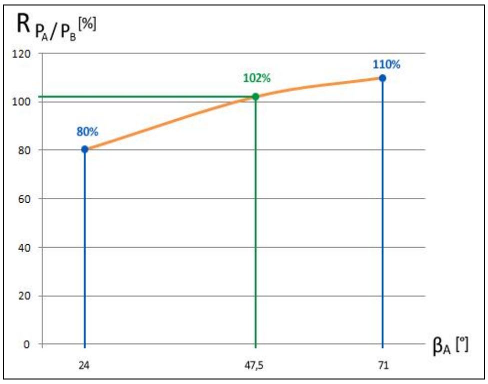

Fig 21 Power relations of collectors in winter, βB= 47.5°

CONCLUSION

Considering the efficient operation of sun collectors Óbuda University established a special measurement station capable of measuring the thermal characteristics of several sun collectors at the same time. Based on the laws of the Sun – Earth relative movement published in the specialist literature we determined the optimal slop angle of the sun collectors at which the energy producing capability of the collector is optimal. In this way we determined a set-up angle for a whole year and the collector slop angles for the four seasons (autumn, winter, spring, summer). Through laboratory measurements we confirmed our conclusions made theoretically. Our measurements made it clear that if the sun collector is not set at the right angle, the power of collector falls by up to 10-20%. Figure 19 – Figure 21 graphically depict this decrease in power due to improper slop angles. If the slop angle of the sun collector is not modified during the year, the power of the collector in summer – when the possibility of energy transformation is the best – is up to 20-30% less than the optimal value. In spring and autumn the operation and energy producing capability of the sun collector is optimal at this slop angle ($\beta = \Phi = 47.5°$).
For the measurements we used a special sun collector developed by we, whose construction cost is lower compared to the commercial sun collectors available in Hungary. In the future we find it necessary to repeat our measurements under more precise circumstances, with more slop angles and at least four collectors in parallel. We hope that those results will give us more accurate information how to modify the slop angles of sun collectors.

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RISK ASSESSMENT OF EXPOSURE TO VIBRATION IN THE WORKING ENVIRONMEN

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Abstract: *This paper deals with a proposal impairment risk from the point of view of long-term exposure to vibrations in a selected engineering production. The measured results show that the normalized levels of vibration exposure, extended by the uncertainty of measurement at the aforementioned workplaces, exceed the limits stipulated by the Slovak Government Decree № 416/2005 Coll. of Laws, and it is evident that according to the Ordinance № 448/2007 Coll. of Laws, all measured professions fall within the fourth category of work activities categorized according to the vibration factor. This paper describes clinical symptoms of the vibration impact on human health using Pareto's analysis, which gives an insight into the nature of the problem and enables to distinguish between vital causes and those that are less important.*

Keywords: *Vibration, health, clinical signs*

INTRODUCTION

The state of health of workers who perform mostly manual work is affected by a whole number of occupational risks including a variety of physical factors. A frequent risk in our industry which is hard to be eliminated either by the improvement of technical parameters of equipment and tools or modernizing the factory operation is exposure to excessive vibrations. [1, 3]
Until recently, there has prevailed a widespread opinion that the problem of vibrations is related to a rather narrowly limited area [4] **of several hundred workers, mostly males working with pneumatic and electrical manual tools and equipment.** [5] At present, the issue is being dealt with in the wider context since from both the scientific and practical point of view it represents a whole complex of complicated problems that cannot be completely solved by one expert [4, 10]
The harmful effect of vibrations on human health depends on the way how those vibrations are transmitted to the body (or individual parts of the body). That is why assessment of vibrations in the occupational environment from the point of view of health protection is performed depending on the type of transmission of vibrations to the human operator.
Diseases associated with vibrations in respect of their frequent occurrence represent a significant health and especially social problem. [6, 12] The impact of vibrations to the human body depends on the amplitude, frequency, acceleration, direction and duration of exposure. The cumulative effect of vibrations manifests itself after exposure lasting for at least 2000 hours, however, generally after more than 8000 hours of exposure. [7, 5] Mathematical models of human body and its subsystems are of great help in describing and understanding the transmission and effect of mechanical energy in the human body. The human body behaves as a complex mechanical system with several degrees of freedom of the system

which includes both linear and non-linear elements and mechanical properties of this system vary and are specific for every person. [2, 11, 19]
A disease resulting from vibrations caused by local transmission to upper limbs takes the third and fourth place in the SK (Slovak Republic ISO 3166-2: SK) from among all the reported occupational diseases. The average age of individuals affected by the vibration related disease is 45.6 years of age. [7, 17, 18]

EXPOSURE ASSESSMENT

By exposure we understand contact of human organism with a physical, chemical, biological or any other harmful factor. Exposure assessment is a quantitative or semi-quantitative assessment of a likely exposure of a man and / or of the environment to sources of risk or to a factor, from one or from multiple sources. Exposure assessment expresses a numerical estimate of exposure or of a dose that can be used for risk characterization and its quantification to human health.
Exposure at work is the result of the method of using a substance or a factor, of an application and of effectiveness of technological, organizational and substitutive measures of the mode of work, of the worker's behavior, as well as of the impact of other physical and chemical factors of the environment. Exposure assessment requires a thorough analysis of work, processing of the time recording and re-measurement of exposures, primarily through personal collection of data. In case of exposures with greater variability of concentrations or of activities, it is necessary to ensure measurement over the duration of several work shifts in order to obtain objective data on the average and maximum exposure. [7]

MATERIALS AND METHODS

The source material used for this experimental proposal was a database of health preventive check-ups from the Clinic of Occupational Medicine and Clinical Toxicology of the Faculty Hospital L. Pasteur in Kosice. The retrospective analysis of 3 files of professionally exposed individuals from different areas of the environment was carried out.
The first group of 47 patients consisted of workers with long-term high exposure to noise. The second group of 47 patients consisted of workers exposed to vibrations and the last third group of 37 patients included workers exposed to the joint effect of noise and vibrations.
The input criterion for incorporating into the database was work in a risky environment and time of working in such an environment for minimum 5 years. In each file, age, sex, length of work associated with the risk and from the lab parameters the stage of exposure were taken into consideration. Basic statistical characteristics of the clinical symptoms are given in Table 1.This database of diseases was used as a data file for the proposed method of the comprehensive assessment of the quality of the working environment. [13, 25, 29]

Definitions of occupational diseases

According to the Protocol of 2002 to the Occupational Safety and Health Convention, 1981 (No. 155), the term **"occupational disease"** covers any disease contracted as a result of an exposure to risk factors arising from work activity. The International Labour Office (ILO) Employment Injury Benefits Recommendation, 1964 (No. 121), Paragraph 6(1), defines occupational diseases in the following terms: **"Each Member should, under prescribed conditions, regard diseases known to arise out of the exposure to substances and**

dangerous conditions in processes, trades or occupations as occupational diseases."
Two main elements are present in the definition of an occupational disease:

- the causal relationship between exposure in a specific working environment or work activity and a specific disease, and
- the fact that the disease occurs among a group of exposed persons with a frequency above the average morbidity of the rest of the population. [23]

In this paper we will work with a group of 47 patients (35 males, 12 females) who selected from among 131 patients of the sample group for the analysis of the clinical symptoms of the effects of vibration exposure on the employees 'health who had worked long-term or working in operations with high exposure to vibrations (see Table 1).

Table 1 Clinical signs in patients exposed to vibration

Number of patient	Code_ISCO_08	Exposure Time		PYAR	Occupational Disease	Reporting Date OD	Clinical Signs										
		from	to				P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	7521, 9333, 8344	1996	2004	8	28	2004	x	x									
2	7221, 8111, 5414, 9333	1980	2011	22	28	2002	x				x				x	x	x
3	7211, 8344	1972	2010	32	29	2004	x	x	x			x			x	x	x
4	7533	1980	2010	30	29	2010	x					x		x	x		
5	7533, 7317	1975	2010	36	29	2011	x	x				x			x		x
6	5242, 9629	1994	2008	12	29	2006	x	x									
7	7221, 7371, 9629	1975	2001	26	29	2001	x	x	x		x	x		x	x	x	x
8	8111, 8343	1986	2001	15	29	2001	x	x			x				x		
9	8111, 8332, 5414	1978	2001	21	29	1999	x	x				x			x	x	x
10	7533	1970	2004	34	29	2004	x	x			x	x		x			
⋮																	
39	7317, 8111, 9312	1993	2012	19	28	2012	x	x			x				x		
40	7533	1974	2008	34	29	2008	x	x				x					
41	8111	1974	1993	17	28	1991	x	x		x	x	x		x		x	x
42	7221, 7212, 7317	1973	2010	38	28	2011	x	x				x			x		
43	7212, 8111	1985	2003	12 18	28	1997 2003	x	x			x					x	x
44	7221, 9311, 7542	1976	2009	28	28	2004	x	x			x	x			x		
45	7224, 7221, 9622	1964	2003	32	29	1996	x	x							x	x	x
46	7224, 9612	1979	2009	19	29	1998	x	x		x	x	x		x	x	x	x
47	7211, 8111, 9629	1983	2003	20	28	2003	x	x			x	x		x			

Response: P0 – tingling in fingers, **P1 –** joint pain, upper and lower extremities, **P2 –** spasm in lower extremities, **P3 –** excessive sweating, **P4** – skin colour change from red to white to blue, along with pain and numbness (Raynaud's Syndrome), **P5 –** not specified difficulty of breathing, **P6 –** headaches, **P7 –** sensitivity to cold, **P8 –** loss of strength in upper extremities, **P9 –** tinnitus, **P10 –** impaired hearing, **PYAR (Person-Years-At-Risk)** [22] – length of exposure given in years, **OD** – occupational disease, **Code_ISCO_08** – International Standard Classification of Occupations, **28 (HAVS) hand-arm vibration syndrome** [26] – disorders of muscles, tendons, bones, joints, peripheral blood vessels or peripheral nerves). **29 –** Carpal tunnel syndrome due to extended periods of repetitive forceful work, work involving vibration, extreme postures of the wrist, or a combination of the three.

The average age of the patients was 54.3 years and the average time of exposure almost 27.5 years. Basic statistical characteristics of the sign such as patient's age (years). Of the 47 patients 26 patients (55.3%) were in the 51 to 60 age, 9 patients (19.2%) were in the 61 to 70 age group and approximately the same numbers (8 patients 17%) were in the 41 to 50 age. Four patients (8.5%) were younger than 40 years.

Overview of ISCO-08

The International Standard Classification of Occupations 2008 (ISCO-08) provides a system for classifying and aggregating occupational information obtained by means of statistical censuses and surveys, as well as from administrative records. It is a revision of the International Standard Classification of Occupations 1988 (ISCO-08), which it supersedes.
ISCO-08 is a four-level hierarchically structured classification that allows all jobs in the world to be classified into 436 unit groups. These groups form the most detailed level of the classification structure and are aggregated into 130 minor groups, 43 sub-major groups and 10 major groups, based on their similarity in terms of the skill level and skill specialization required for the jobs. This allows the production of relatively detailed internationally comparable data as well as summary information for only 10 groups at the highest level of aggregation.
The classification was adopted by a tripartite Meeting of Experts on Labour Statistics on updating the International Standard Classification of Occupations (ISCO) held from 3 to 6 December 2007. [20, 21, 24]
Main sources of vibration and extent of workers' exposure
Directive 2002/44/EC [15] of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) lays down minimum requirements for the protection of workers from risks to their health and safety arising, or likely to arise, from exposure to mechanical vibration during their work. [16]
According to Eurofound's European working conditions survey (EWCS), an average of one in three workers in Europe is exposed to some kind of vibrations whatever the source, tools or machinery and one in four is exposed at least a quarter of the time. These data are shown in Figure 1.

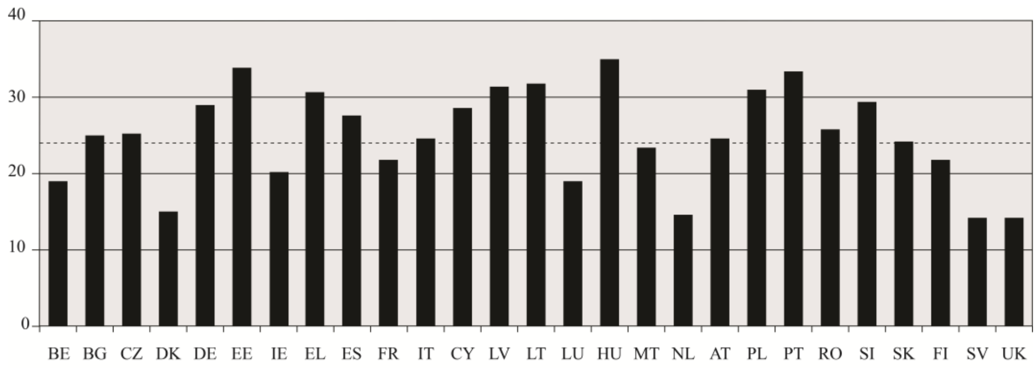

Figure 1 Percentage of workers exposed to vibration from hand-tools, machinery, etc., at least a quarter of the time by country (Eurofound, fourth EWCs) [16]

The European Committee for Standardisation, or CEN (www.cen.eu), has published two standards that provide practical guidance for tackling the risks related to vibration. **The first is CR 1030-2:1995**, HAV — Guidelines for vibration hazards reduction — Part 2: Management measures at the workplace. This guideline outlines measures for the reduction and control of health hazards associated with exposure to HAV at work in order to provide a practical, professional aid to managers and health and safety officers. The document covers four principal aspects:

- identification of main sources of HAV within the firm;
- vibration reduction by reconsidering task, product, and process and redesign;
- how to select low vibration machinery, anti-vibration systems and personal protection;
- management measures for the control of HAV exposure.

The second standard covers WBV: CEN/TR 15172-2:2005, Whole-body vibration Guidelines for vibration hazards reduction — Part 2: Management measures at the workplace. [16]

RESULTS

The analysis showed that all the patients have tingling of hands (P0). As many as 87.2% (41 patients) joint pains, upper and lower extremities (P1) and 68.1% (32 patients) suffer from loss of strength in upper extremities (P8). Percentual distribution of other signs is given in Table 2.

Table 2 Diagnosed clinical signs

Signs	**P0**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Number of patients	47	41	6	2	25	20	3	17	32	16	21
Percentage of patient (%)	**100**	**87.2**	**12.8**	**4.3**	**53.2**	**42.6**	**6.4**	**36.2**	**68.1**	**34.0**	**44.7**

The signs are grouped according to the absolute frequencies of their prevalence as well cumulative absolute frequencies and cumulative relative frequencies which are given in Table 3.

Table 3 Frequency table for creating a Pareto chart

Sign code	**Frequency**	**Cumulative absolute frequency**	**Cumulative relative frequency**
P0	**47**	**47**	**20.4%**
P1	**41**	**88**	**38.3%**
P8	**32**	**120**	**52.2%**
P4	**25**	**145**	**63.0%**
P10	**21**	**166**	**72.2%**
P5	**20**	**186**	**80.9%**
P7	17	203	88.3%
P9	16	219	95.2%
P2	6	225	97.8%
P6	3	228	99.1%
P3	2	230	100.0%

Table 3 and the Pareto chart (Fig. 2) show that more than 80 percent of all recorded problems in 47 patients are caused by **six signs: P0, P1, P8, P4, P10 a P5.**

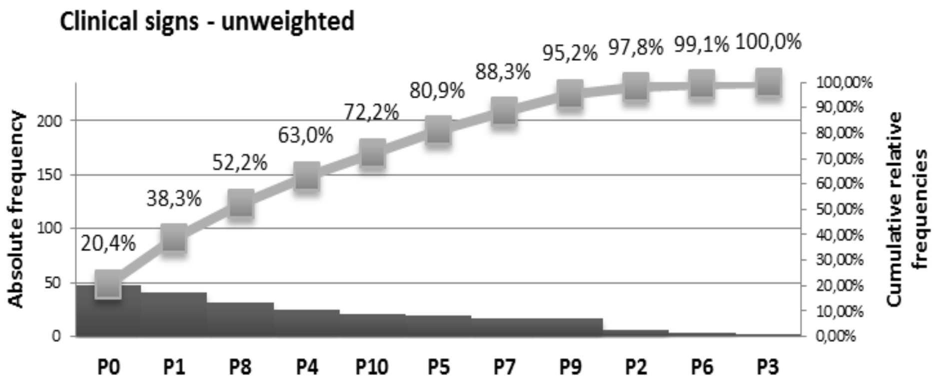

Figure 2 Pareto chart

Chronologically, each of the symptoms associated with vibration exposure in the working environment was expertly rated according to the level of severity of condition and impact on the human body on a point rating scale ranging from 1 to 5 to determine the importance of these clinical symptoms (1 – very mild, 2 – mild, 3 - average, 4 – severe, 5 – very severe). The aim of this determination was to form a team of experts in this area who would provide independent objective point rating of individual symptoms. The signs are grouped according to the weighted frequencies of their prevalence as well cumulative absolute frequencies and cumulative relative frequencies see Table 4.

Table 4 Frequency table for creating Pareto chart – signs with weights

Sign code	Frequency	Weight	Weighted frequency	Cumulative absolute frequency	Cumulative relative frequency
P0	**47**	**5**	**235**	**235**	**25.6%**
P1	**41**	**5**	**205**	**440**	**47.9%**
P8	**32**	**5**	**160**	**600**	**65.4%**
P10	**21**	**4**	**84**	**684**	**74.5%**
P4	**25**	**3**	**75**	**759**	**82.7%**
P5	20	3	60	819	89.2%
P9	16	3	48	867	94.4%
P7	17	2	34	901	98.1%
P2	6	2	12	913	99.5%
P6	3	1	3	916	99.8%
P3	2	1	2	918	100.0%

Table 4 and Pareto chart (Fig. 3) show that more than 82 percent of all the recorded problems in 47 patients are caused by **five signs: P0, P1, P8, P10 a P4.**

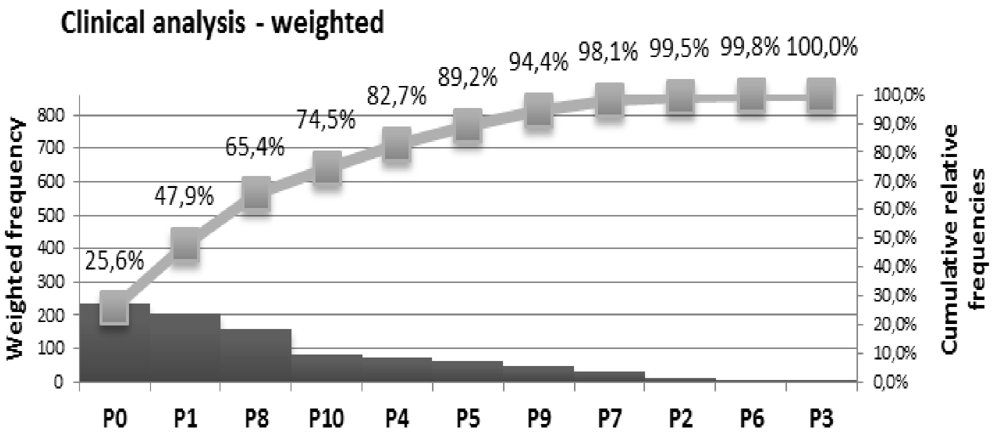

Figure 3 Pareto chart - signs with weights

CONCLUSION

The main purpose of this work was to develop new, not yet published methodology for the assessment of working environment factors based on the analysis of theoretical resources and the current knowledge covered in domestic and international publications. Our proposed methodology can be used for the assessment of clinical symptoms associated with the effects of vibration exposure on human health in operations with high exposure.

Through monitoring of the diagnosed clinical signs of exposure to vibration and its effects on human health as well as using a weighted Pareto chart it was found out that more than 84% of the recorded health problems were caused by five signs: ***impairment of hearing, buzzing and ringing in the ears, breathing problems, tingling of hands and join pain of upper and lower limbs.*** A similar result was also obtained in the case of the analysis of signs without determining weight according to the level of seriousness and effect on the human body. It is important to be aware of the fact that the issue of assessment and evaluation is very complicated and therefore there exist a lot of different approaches to tackle the problem. The technique of assessment of clinical signs presented by the authors in this paper is one of the possible solution methods of this problem available. The results presented here are based on the authors' practical experience in this area.

This experimental proposal provided us with answers to a number of questions, but also opened up a series of new ones. The authors suggest further investigation of this issue that lies first of all in an extension of the investigated sample group of exposed employees and more detailed examination of the clinical symptoms required for further application of the above-mentioned techniques and verification of the formulated conclusions.

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CONTRIBUTION OF IPA CBC PROJECTS IN THE DEVELOPMENT OF ACADEMIC THOUGHT ON THE SUSTAINABLE DEVELOPMENT

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Abstract: *Sustainable development is the development that satisfies the needs of current population without threatening the needs of future generations. The European Union has started the realization of European Union sustainable development through sustainable development of its regions. One of the means for supporting the sustainable development is IPA CBC project programme. This paper presents one such IPA CBC project between Republic of Serbia and Romania, i.e. between Technical Faculty "Mihajlo Pupin" from Zrenjanin, University of Novi Sad and "Politechnica" University of Timisoara. Academic youth, today and always, has been a carrier of new ideas and activities and it is natural that it actively participates in definition and implementation of the sustainable future. Having that on mind, project had a goal to educate students from both institutions on the issues of sustainable development and environmental protection. Their progress and academic thinking was measured through series of questionnaires.*

Keywords: *IPA CBC projects, sustainable development, academic thought*

INTRODUCTION

Banat is a geographical and historical region in Central Europe divided between three countries: the western part lies in Serbia (the Serbian Banat, mostly included in the Vojvodina region, except for a small part included in Central Serbia), the eastern part in Romania (the counties of Timis, Caras - Severin, Arad south of the Mures/Maros river, and Mehedinti), and a small northern part in Hungary (Csongrád county).

Parts of Banat on the Romanian and Hungarian side of the border belong to administrative region of the European Union, while Serbian part of Banat still doesn't belong, but it strives to accept European norms and achieve the status of European region. Whole Banat region will in that way become a part of the European system of sustainable development.

The term sustainable development was designed in 1989 and proclaimed by Bergen Declaration (1990). It denotes the possibility of further development both the present and of the future generations. This means that the present generations should plan and create the environmental quality for themselves, and at the same time make it possible for the future generation to achieve the same quality. Possibly the most accurate definition of sustainable development is the one that appears in the UN "Brundtland Report" that states: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
Basic principles of sustainable development are based on Agenda 21 from Rio de Janeiro [1] and are the basis for future directions of development of civilisation. With documents Review of the EU Sustainable Development Strategy (1091/06), COM 2001/0264 final, COM / 2005/0658 final, and European Union has started the realisation of European Union

sustainable development through the sustainable development of its regions.

The idea of sustainability in Serbia is firmly connected with its European integrations that take place from 2000 and onwards. The Republic of Serbia has started development of its own strategy in 2005, with the help from various European institutions and governments. Serbian sustainability strategy is based on the following principles: economy based on knowledge, social issues and environmental care [2]. Those three pillars of modern Serbian development are planed to be fully implemented by 2017. Sustainable development strategies are also created on the regional levels (e.g. Banat region), and on municipality levels (e.g. Zrenjanin municipality [3]).

COOPERATION BETWEEN ROMANIA AND SERBIA

One of the means of European Union for supporting the sustainable development is through IPA CBC project programme. The Instrument for Pre-Accession Assistance (IPA) offers assistance to countries engaged in the accession process to the European Union (EU). The aim of the IPA is therefore to enhance the efficiency and coherence of aid by means of a single framework in order to strengthen institutional capacity, cross-border cooperation, economic and social development and rural development.
The Romania-Republic of Serbia IPA Cross-border Cooperation Programme targets selected border regions between Romania and Republic of Serbia. This Programme provides the opportunity for both countries to continue their cross-border cooperation under the Instrument for Pre-accession Assistance (IPA). The strategic goal of the Romania-Republic of Serbia IPA Cross-Border Cooperation Programme is to achieve a more balanced and sustainable socio-economic development of the Romanian-Serbian border area, on the basis of joint cross-border projects and common actions by Romanian and Serbian stakeholders [4].
Before IPA CBC projects, Romania and Serbia cooperated through Phare External Border Initiative Programme for Romania and the Neighborhood Programme Romania- Serbia & Montenegro.

BANAT REGION’S SUSTAINABLE DEVELOPMENT ACADEMIC CAMP

“Banat region’s sustainable development academic camp” was the project that was financed by the European Union through the Neighbourhood programme Romania - Serbia, which was the direct predecessor to the currently active IPA CBC project programme. The premise and guiding motive for the project was that academic youth has always been a carrier of development ideas and activities and it is natural that it actively participates in the definition and implementation of sustainable future development.
Project was implemented by the Technical faculty „Mihajlo Pupin“ as the managing partner, and its partners Politehnica University of Timisoara and Technical faculty in Bor. Each participating partner was, and still is a leader in the higher education in their respective regions.
The goal of the project was to analytically define, raise the level and intensify activities on implementation of the regional sustainable development through partnerships between students, professors and institutions of higher learning in the cross-border region. This exchange of knowledge improved teaching methods, educational system, and clarity of definition of achieved levels in regional sustainable development, created and defined

starting points and directions for further cooperation with the goal to satisfy final beneficiaries of sustainable development process.
Anticipated results of the project were: defined cooperation types between students, professors and education institutions of higher learning in Banat region, improved cooperation between students, professors and education institutions of higher learning in the region, improved knowledge in the field of environmental protection and sustainable development in general, definition of the initiative document that describes the future type of cooperation between students, professors and education institutions of higher learning.

Central activity on the project was academic camp, in which participated 30 students from partner universities and 6 teachers (professors). Camp was envisioned to be an incubator of regional cooperation between students of Romania and Serbia. Education in the camp was realised through active learning technics and various other teaching methods. Lectures were organised during 10 days, i.e. entire duration of the camp. Simultaneously with educational activities, students participated in sports and other activities (tours and visits).
Final beneficiaries of the camp and the project were, besides 30 participating students, students from the region, international student’s organisations, institutions for environmental protection from Banat region, academic citizens interested in sustainable development, local, regional and international institutions of higher learning.

EDUCATION AND ACADEMIC THOUGHT ON SUSTAINABLE DEVELOPMENT

Promotion of sustainable development through education transcends the boundaries of the education paradigm allowing the classification of formal, informal and non-formal modalities. Education for sustainable development requires cooperation and partnership among many decision- making factors: central and local authorities, education and research units, public health system, the private sector, manufacturing industries, transport, agriculture, commerce, the labour unions, mass-media, non-governmental organisations, local communities, citizens and international organisations.
Education for sustainable development must not be limited to an environmental perspective. It should develop as a broad, inclusive concept, bringing together interconnected environmental, social and economic aspects. Tackling the broad and diverse array of topics associated with the principles of sustainable development requires an inter- and trans-disciplinary approach through integrated, cross curricular and mutually reinforcing educational forms, which should also take into account specific local, regional and national conditions, as well as the global context.
Through the measures that were envisaged, Romania’s educational system combines the traditions of the national school with the principles of education for sustainable development [5]. The thematic substance is thus integrated in the formal, informal and non-formal educational systems through a three-dimensional approach: socio-cultural, environmental and economic.
Socio-cultural educational content embracing local and universal concerns: human rights, peace and security, gender equality, cultural diversity, inter-cultural education, education for health and the quality of life, education for leisure, good governance (transparency, free expression of opinion, freedom of speech, participation in policy-making), appreciation of national heritage and local history.
Education about and for the environment: the objectives of environmental protection in the processes of development, environmental quality, conservation, protection and improvement

as development goals, education for the regeneration of the natural environment, education for recycling and re-use of material resources.

Technological and vocational training: acquisition of competences and proactive attitudes (to understand the real world as a common good; to possess general knowledge and to specialise in a given field; to go on learning and to pursue education throughout one's life in a learning society), abilities and aptitudes (to work individually or as part of a team with integrity and honour; to be honest, punctual and responsible; to adapt to changing circumstances; to know and understand problems and difficulties; to apply creative, critical thinking to problem-solving; to resolve conflicts without recourse to violence); ethical approach to development in a sustainable society.
Considering previously said the aim of the camp and training was to give students the opportunity to acquire a systems perspective on the industrial society, and based on that, develop their insights into restrictions and possibilities that follow from the need to transform the industrial society to conform to a sustainable development. Besides attaining knowledge of the concept of sustainable development, including different perspectives on this concept, students learned about strategies and tools for analysing the environmental impacts of societal use of land, energy and materials, and for changing this use into a more sustainable direction. The following issues were covered:

- meaning of sustainable development and its three principal dimensions: the ecological, the economic and the social dimension,
- major restrictions and options for the use of resources and technologies from the standpoint of sustainable development,
- socially and economically related conflicts of interests that may block implementation of sustainable development,
- strategies, international agreements and major policy instruments for a sustainable use of resources and ecosystem services,
- relevant analytical concepts, and capability to use these for analysing issues related to sustainable development,
- major tools and methods for analysing and improving sustainability characteristics of products and industrial processes.

The entire educational and training system internalised the principles and objectives of sustainable development as an integrator of the knowledge, aptitudes and skills that are needed for personal and socio-cultural performance in the modern world. Education for sustainable development was integrated laterally in all syllabuses, either as sets of subjects or as modules, from nature sciences to civic responsibility to sustainable production and consumption patterns relative to available resources to the principles of cultural diversity, good governance and the rule of law.

METHODOLOGY

In order to assess the quality of the camp, and level of newly acquired knowledge of students, two questionnaires were designed and conducted. First questionnaire was carried out before the academic camp, and it consisted from 18 questions designed to determine the student's expectation of the camp, as well as the current level of their knowledge on the sustainable development. After the camp, students participated in another questionnaire. The second questionnaire had two parts. The first one was knowledge test and it was composed of 30 questions about sustainable development. The second part was composed of 21 general questions regarding the camp organisation and students impressions. Afterwards, questionnaires were statistically analysed and results were presented.

RESULTS OF THE TEST AND QUESTIONNAIRE

Knowledge Test Results

The camp participants have demonstrated a solid knowledge of the material presented throughout the camp. For almost all of the questions, there has been a clear majority of 25 students and above selecting the correct answer. As a breakdown of areas the following assessment has been made.

For questions 1 – 7 the majority answered correctly although different opinions were expressed for question 4 ("How many mechanisms does Kjoto protocol have?"). The next group of questions concentrated on the history of Banat area, where the highest majority of students correctly answered the questions.

The last grouping of questions had similar results as to the previous groups. All together the group had a very good result. There were very few questions that had distributed answer selections. These include topics such as air pollution measurement and advantages of renewable energy resources. There seems to be a parallel with the weaker knowledge areas and the subjects students chose future camps should concentrate on.

Review of questionnaire

In the initial section of Part II, the students were asked to rate various segments of camp on a scale from 1 to 5, 1 being the lowest grade and 5 the highest. Internet availability, which was presented as a very important facility in the first questionnaire, had the largest group of people (22) rating it excellent. Secondly, the majority of the group rated transportation organisation with an excellent and quality of accommodation with an above average. The next few segments, field trip organisation, location of camp, lecture facilities and organisation had an evenly spread grading ranging between satisfactory to excellent. Although quality of food, had distributed rating across the specter, 3 students rated it unsatisfactory. None of these students were vegetarian.

Overall, as seen in figure 1 below, participants were satisfied with the quality of camp, as most segments have received the majority rating above average and excellent.

All of the students answered that similar camps should take place in Romania and that they would like to attend future cooperation. As majority of them believe that these camps enrich their knowledge of the people, culture and lives of people from different countries, they all would like to see participants from other neighbouring countries in future camps. Furthermore, the majority (26) believes that this kind of cooperation between two countries aid and develop the idea of a unified Europe. In addition, the average rating for these camps as an aid in development in cooperation between Romania and Serbia is believed to be above average.

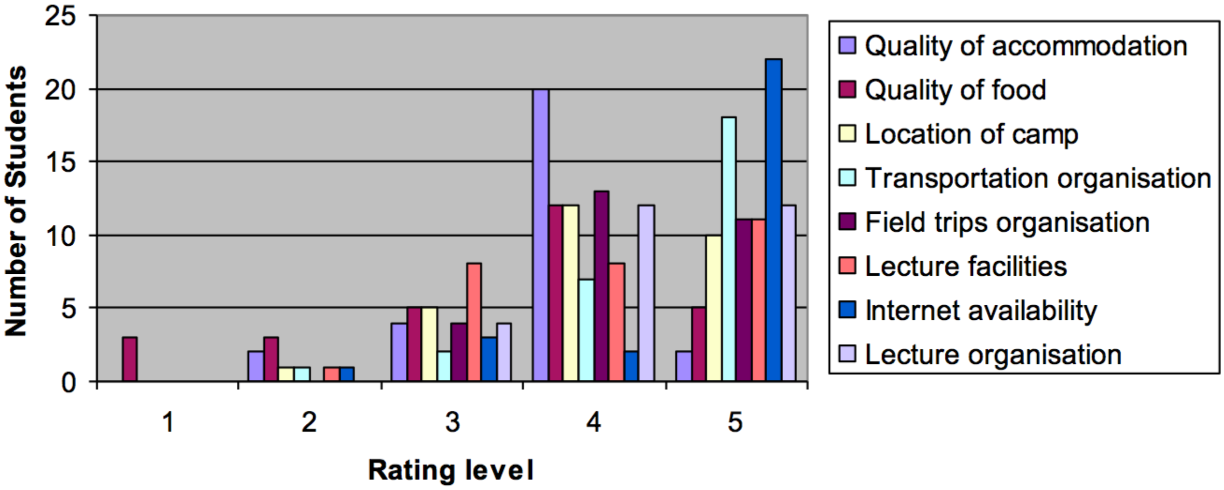

Figure 5: Students rating of camp facilities and organisation

The initial questionnaire displayed that the students wanted to firstly gain new friends, closely followed with gaining knowledge about Sustainable Development. Thirdly, they wanted to have information about Banat area and lastly information on the Serbian educational system, as seen on figure 2 below.

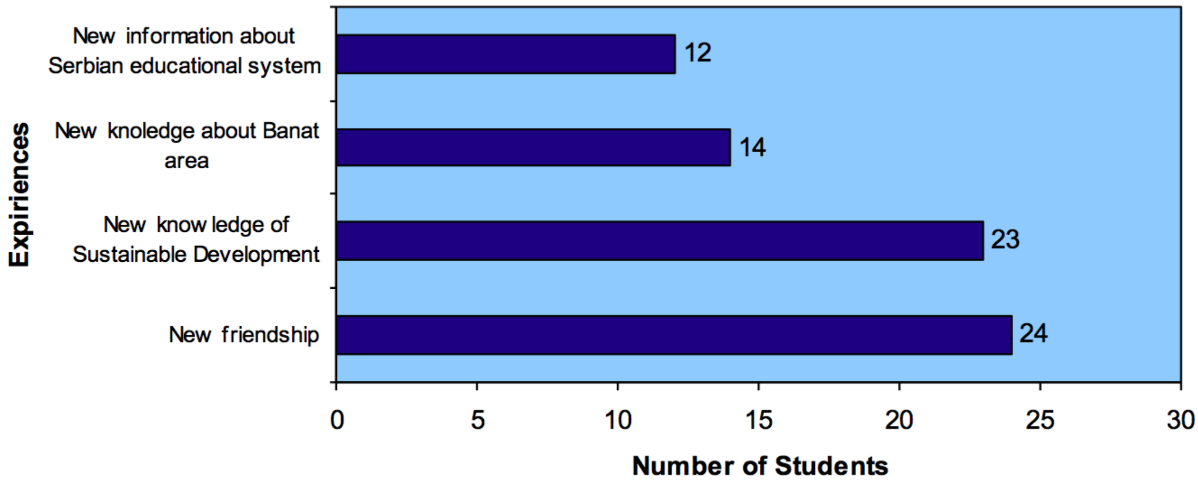

Figure 6: Desired camp outcome

The following figure 3 demonstrates the actual outcomes according to the students. The most important gained experience was new friendships, followed by new knowledge gained about Sustainable Development. Knowledge about Banat area and information about Serbian educational system were voted as least important.

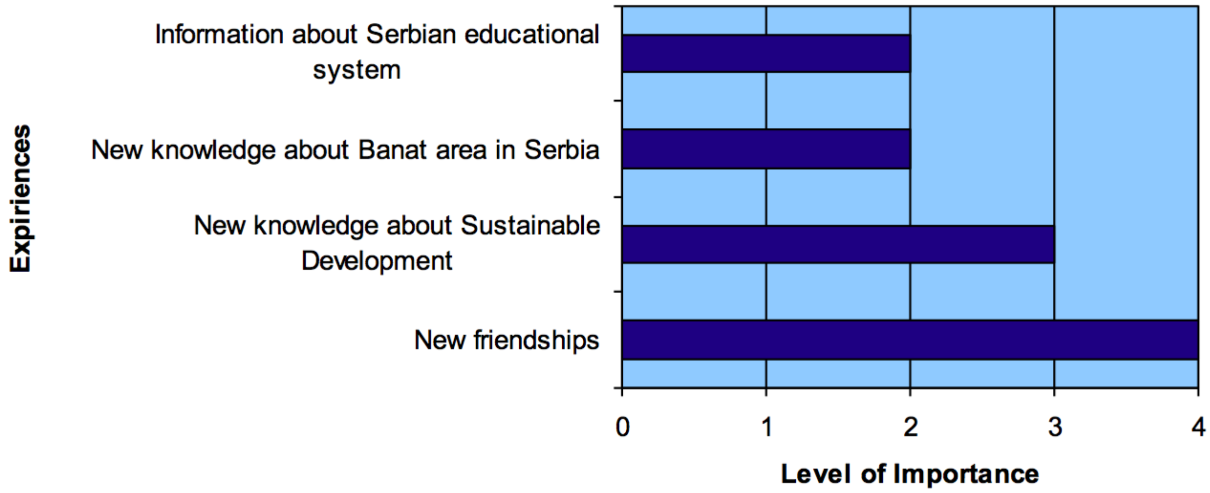

Figure 7: Experience achieved rated according to importance from 1 to 4

A portion of the questionnaire concentrated on improvement of future camps. The figure 4 depicts how important certain thematic has been to the students. The highest priority was the quality of region's leading environment in Banat area, whilst the lowest was the region's cultural heritage (current conditions and sustainability).

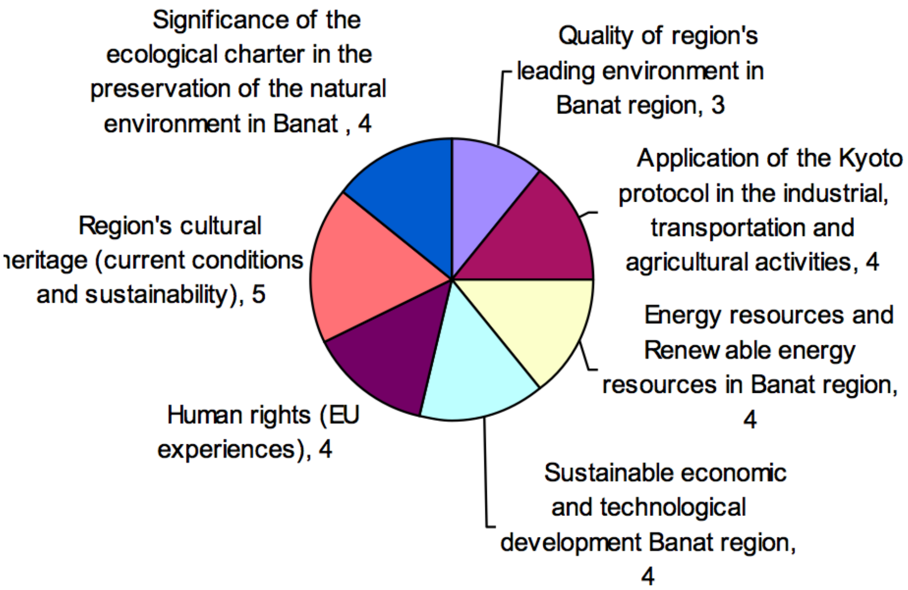

Figure 8: Themes which should be prioritised in future camps

Additionally, in a free format the students expressed which activities or lesson they would like to see in future camps, figure 5. The most frequently mentioned were lessons on recycling, followed by renewable energy and further elaboration on Sustainable development. Similar number of people wanted to have more team activities and field trips.

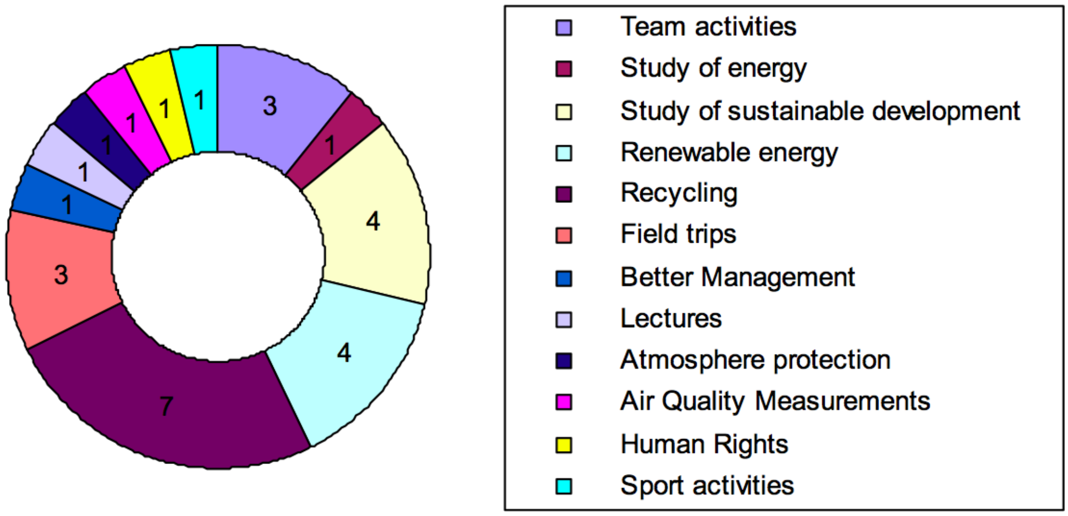

Figure 9: Activities and lessons which should be prioritised in future camps

Lastly, figure 6 demonstrate what left the biggest impact on them during the camp.
It is evident that the students were most pleased with the friendships they gained throughout the duration of camp and the lectures that took place.

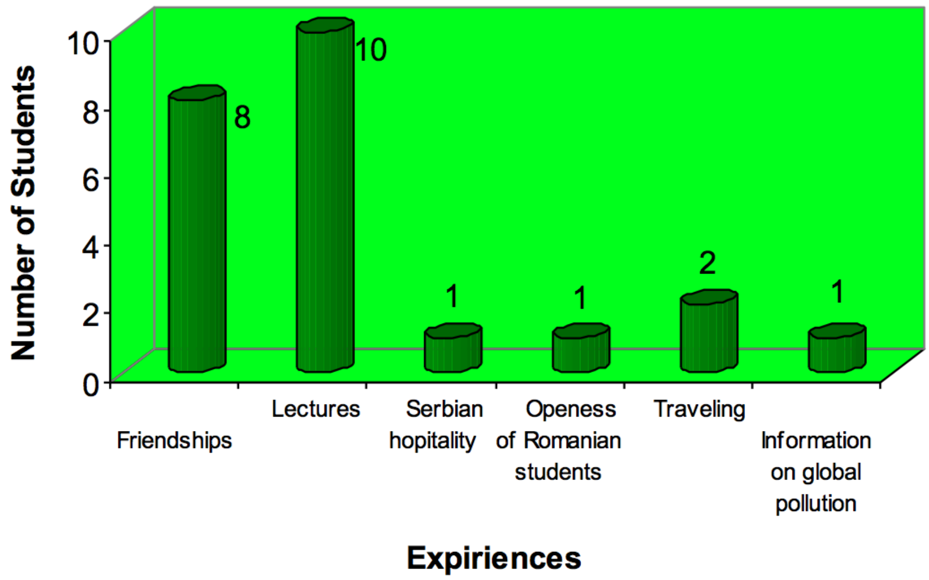

Figure 10: What left the biggest impact on students

CONCLUSION

The Banat Region's Sustainable Development Academic Camp, which lasted 10 days and had 30 students from Serbia and Romania has met and exceeded the participant's expectations. They took part in lectures, field trips and sport activities all with the aim to strengthen the relationship between the students from the two countries mentioned above

and deepen the interest for Sustainable Development in the region. As seen from the results, all of their expectations have been met and the majority considers these camps to aid to the development of a unified Europe.
Through this project, implemented within the Serbia and Romania's cross-border cooperation program, pioneering stimulus has been given to the student youth cooperation in the Banat region. Cooperation of the students at the university institutional levels was virtually inexistent until the realization of this project. Need for cooperation has been apparent historically and at the present day, but it has not been systematically initiated until it was identified by the authors and supported in the form of the cross-border cooperation project. Magnitude of the positive significance and necessity of their decision to implement this project has been reflected in the statements presented during project workshops, cooperation during project realization, as well as proposed further forms of actions and directions of cooperation within and outside of the Banat Region.
Sustainable development is a main motive for the European Union and thus represents one of the most important areas of scientific and academic research. Today's academic youth will produce tomorrow's leaders and it is of vital importance that they are knowledgeable on the topic of sustainable development. This cross border project showed that students are interested in sustainable development and that multi-national and multi-cultural academic camps present the good way for enlightening the students and improving their thoughts in the area of sustainable development.

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ENVIRONMENTAL STRESS RESPONSES IN LACTOCOCCI ISOLATED FROM THE ALGERIAN CAMEL MILK

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Abstract: *Dromedary's milk constitutes an important protein source in pastoral societies; it is traditionally fermented from natural flora that contains a large panel of lactic acid bacteria in particularly Lactococcus lactis which has been associated with food production and preservation since ancient times. From an industrial point of view it is important to select strains that perform well in fermentation and that resist adverse conditions occurring during the fermentation process. In addition, such strains should survive storage and handling procedures that are cheap and convenient. A number of (physical) parameters can be manipulated to control lactococci without changing the safety and nutritive value of the final product. Obviously, growth studies confirm that L. lactis is a mesophilic. It is, however, able to survive more harsh conditions, which is the case of our lactococci isolated from the Algerian camel milk in particularly when incubated at high temperature (50°C). In this study we are interested to reveal the genetic determinants of heat resistance shown by twenty-two atypical lactococci. We are interested in the isolation, cloning and the expresion of the genes involved in this character. This heat resistance character shown by our strains may be important to make a relationship between the hot ecosystem, particularly of arid area and the genetic adaptation's systems of these bacteria to heat stress.*

Key words: Lactococci, heat resistance, variants, genetic determinism, camel milk

Introduction

In Algeria, the study of lactic acid bacteria from camel milk is purely fundamental, current research reveal the identification of new atypical strains belonging especially to the sub species *lactis* of *Lactococcus* (Drici and al., 2010). The valuation of these beneficial microorganisms should be a research priority. This will pave the way to applied studies, including the production of local lactic ferments adapted to the different Algerian dairy ecosystems in particular camel milk including the lactic flora presents features specific to arid ecosystem. It is in this context that we have opted in this study to the valorisation of lactococci from raw Algerian camel milk, which some are characterized by exceptional thermotolerance. Our study is based on physiological and genetic approaches which the compilation helped us to partially reveal the genetic support of heat resistance. Fifteen proteolytic lactococci were screened for their heat tolerant caracter. Among 15 heat resistant straines tested, 9B strain showed a high ability to develop at 50°C on M17 medium.Obtained heat sensitive variants are in favour of a genetic determinism of thermotolerance which appear to be in plasmid or included in a transposon.

Material and methods

1- Strains and media

Fifteen lyophilized strains, belonging to the *Lactococcus* genus and isolated from the Algerian camel milk (Drici and al., 2010), have been studied for their heat resistance character. 3 MD strain isolated from the goats milk in the region of Oran; which is part of the collection of the laboratory of Microbiology "LMA", Oran University; is used as a positive control, which grows at high temperatures up to 50°C. M17 Medium (Terzaghi and Sandine, 1975) is nutrient-rich to the growth of acid lactic bacteria, and used for the enumeration and the purity verification of lactococci (particularly *Lactococcus lactis*).

2- Growth condition

2-1- Culture

5 ml of liquid M17 medium (overnight cultures) were used to inoculate 10 ml of M17 liquid medium. Cultures were incubated without agitation at 30°C or 50°C. This condition is also used for the study of the bacterial growth kinetics for 7 h. In solid medium cultures are incubated at 30°C, aerobically as lactococci are microaerophilic and thus tolerate small quantities of atmospheric oxygen.

2-2- Optic density measurement

A bacterial suspension of lactococcal cell density is measured by turbidimetry at 600 nm. In M17 medium the optical density is directly raised.

3- Heat resistance test

From the preserved tubes (-20°C), cultures were made on a solid or liquid medium in the same manner described above. And were incubated at three different temperatures: 37°C, 45°C, 50°C. All 15 strains were incubated at three temperatures, in solid or liquid medium at the same time, using the same volume of inoculum (75 µl) into each tube. The test was performed 3 times successively to confirm the result.

4- Screening of thermotolerant lactococci

From overnight cultures of fifteen heat resistanct strains selected previously on M17 liquid medium, Stock cultures optical density (OD) have been measured the next day. A defined volume calculated according to the concentration of the stock culture from each overnight growth were taken, was used to inoculate 8 ml M17 liquid medium tube and was completed with the same medium to a final volume of 10 ml in order to have a same initial optica density where: DOi = 0.05 in cultures of T_0 and we apply the following formula

$$OD_1.V_1 = OD_2.V_2$$

Cultures were incubated at 50°C and OD was measured at T_0 = 0 hours, T_1 = 4 hours, T_2 = 6 hours.

5- Study of the kinetics growth in M17 liquid medium (at 30°C and 50°C)

For the kinetic study the choice was oriented towards the following strains: 9B, 13C (see results). 3MD Strain is taken as a control. The same manner as described previously, the kinetics of growth of these three strains were established for 8 hours by measuring the OD every 30 minutes.

6- Curing of two fast-growing thermotolerant strains 9B and 13 C

In the aim of curing some plasmids from strains 9B, 13 C and 3MD, these strains have been grown during 10 days successively in M 17 glucose liquid medium (Fantuzzi et al., 1991). 10 ml of this M17 medium are inoculated at each subculture with 100 µl of previous bacterial culture.

From the culture (12th day), 50 or 100 µl of the bacterial suspension are used to inoculate M17 glucose solid medium, were incubated at 30°C for 18 h. Each plate was divided into 4 parts and 3 colonies were chosen randomly from each quadrant. According to the method of patches culture was made on plates containing M17 glucose and was incubated at 30°C for 18 h. M17 glucose liquid medium was inoculated with the patches, and was incubated at 30°C for 18 h.

6-1- Heat resistance test of cured strains

Two plates containing M17-glucose solid medium were inoculated by patches then incubated at 30°C and 50°C.

Results and discussion

This study focused on the valuation of 15 proteolytic lactococci isolated from raw camel milk of Algeria. As a first step, we proceeded to the screening of 15 thermotolerant lactococci able to grow at 50°C. We have thus first thermotolerant proteolytic lactococci constituting a new model for the study of lactic group. Some strains of these thermotolerant lactococci were investigated for physiological and genetic studies.

Physiologic analysis

The physiological aspect mainly concerned the comparative study of the kinetics growth in M17 medium at 30°C (optimum temperature for growth) and at 50°C (Figure 1).

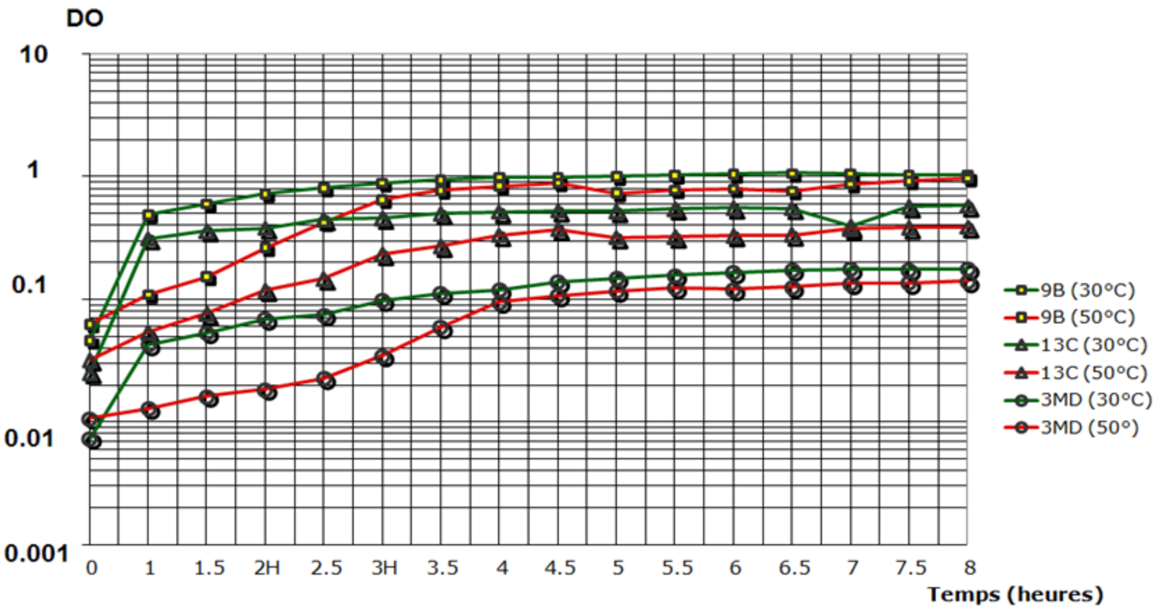

Figure 1: Kinetics of growth at 30°C and 50°C in M17 medium of lactococci from camel milk (9B and 13 C) or from goat's milk (3MD)

The curves describing the kinetics of three lactococci grown in M17 medium (Figure1) do not reflect the classic appearance of growth curves of lactococci already studied where the different phases are detected (De Roissart, 1994). Only the exponential and stationary phases appear for the three strains studied (9B, 13 C and 3MD). The growth temperature seems to influence the duration of the exponential phases. Indeed, at 30°C the exponential phases of three strains are very short and last only 1 h. While at 50°C two growth behaviors are noticed according to the studied lactococcal strains:

- Lactococci 9B and 13 C present the same aspect of curve, where 9B strain is the fastest.
- Lactococci 3MD present a different aspect with the presence of two exponential phases where the generation time of the second phase is short.

In conclusion, we note that the growth of these three lactococci tested on M17 medium under the influence of a temperature effect and origin of strain.

Genetic study

In order to seek the genetic support of thermotolerance in lactococci 9B, 13 C and 3MD, we have adopted as a strategy the plasmids curing from these strains according to the method of Fantuzzi and al. (1991).

Obtaining and analysis of cured strains

After several successive sub-cultures over a period of 11 days, we have chosen randomly the colonies which may correspond to the cured strains and which have lost the ability to grow at 50°C.
Note that the cured ones have lost their ability to grow at 50°C, while their development was normal at 30°C. That assumes that the character of thermotolerance (heat resistance) is not stable because it is lost after several generations (12 successive subcultures).
This result allows us to make the hypothesis that the character of thermotolerance can be carried either by one or more plasmids or even located on a conjuguatif transposon, knowing that the genetic determinant of heat shock proteins in lactococci is chromosomic (Bolotin et al., 2001).

These results lead us towards the exploration of heat shock proteins HSP in these lactococci and to compare them with hsp already described and characterized. This result also encourages us to determine the structure and the regulation mode of proteins expressed at 50°C. These new molecules seem to play a crucial role in the maintenance of the entirety of the thermotolerant lactococci.

Conclusion and perspectives

The analysis of the different results obtained allowed us to highlight the remarkable adaptation of lactococcal 9B at 50°C showing the best growth at this temperature. These interesting results can be used to establish a relationship between the hot ecosystem, including arid regions and adaptation genetic systems of this lactococcal to heat stress. For this reason, we are oriented towards the search for the genetic determinism of thermotolerance.
Obtaining of thermosensensitive variants is correlated with a plasmidic determinism or included in a transposon. The analysis of these variants revealed the loss of their growth at 50°C.

All the obtained results, allow us to consider different perspectives. A deep search of the genetic determinism of thermotolerance in the lactococcal 9B is necessary. This perspective is based on extraction and transfer of DNA techniques: identification and characterization and may be plasmid sequencing. Thus, the reponsible genes can be identified, cloned and expressed.

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CHANGES OF PHYSICAL PROPERTIES OF SOIL AFTER OVERFLOWING

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Abstract: *Dry retention reservoir Beša is very interesting area from point of view of water, landscape, ecological and agricultural. Non-regularly ecological stability of polder Beša is disturbed by its artificial overflowing in time of special flood situations. Results obtained in years 2009 and 2012 were compare for quantification of changes of selected physical properties of soils. Four soil textures (sandy-loamy soil, clay-loamy soil, clayey soil, clay) were observed. Soil samples were taken from depth 0.0 – 0.6 m, from each 0.2 m. Soil physical parameters were determined bulk density, total porosity, maximum capillary capacity. Overflowing of this area in year 2010 contributed to increasing of soil bulk density and decreasing of total porosity. Based on the obtained results from ground survey can be assumed negative changes in soil properties after flooding of the polder Beša area. Development of physical soil properties in the dry polder Beša will be subject to further observation.*

Keywords: *Overflowing area, soil texture, physical soil properties*

INTRODUCTION

More common occurrence of extremely meteorological events (torrential rains, floods and extremely droughts) is demonstration of global climate change as well as changes in the soil ecosystems [5]. By reason of retention of flooding water the dry polder are constructed [10]. On the East Slovak Lowland the dry polder Beša was constructed in year 1965 for retention of flood water in Bodrog river catchment. The polder is saturated only exceptionally at special flood situations, when no-keeping of agreement of maximum flow and water-table of Bodrog River in Streda above Bodrog is possible [1]. The polder is discharge after the decreasing of water-table of Laborec River and after drying of this area before flooded plots may be cultivated. Area of dry polder Beša is landscape compound from various ecosystems (forests, natural meadows and pastures, water ecosystems, agro-ecosystems). For these ecosystems is typical high degree of biodiversity [8]. The human activities in longer and no-regularly time interval destroy the ecological landscape stability of this area and it constrained overflowing of polder. Non-overflowing of polder area effect no only water regime of this area, but also influence on properties of soil textures localized in polder. Dry polder Beša is non-regularly overflowing area and is located to south east part of the East Slovak Lowland (ESL) near Beša village. With its area of 1568 ha and the retention capacity of 53 million m^3 of water is the largest dry polders in Central Europe [14]. Since, its introduction into service Beša polder in 1965 has so far been saturated seven times: November 1974, January 1979, July 1980, March 1990, April 2000, March 2006 and May – June 2010. Most of the retention volume of the polder was used in 1974 (83.02%) and 2000 (78.11%). The aim of this work was to quantified changes of selected physical properties of soils in the polder Beša by compare of results obtained in years 2009 and 2012.

EXPERIMENTAL

In year 2009 in dry polder Beša ended solution of project "Quantification of no-production functions of soil and land in dry polder Beša". In year 2012 in dry polder Beša started researching of project "Analyse of soil properties and landscape development of non-regularly overflowed areas". This project builds on the previous one and focuses on the quantification of soil properties changes in the polder Beša after flooding in 2010. The ground survey was realized in year 2012 on four soil profiles which represented the soil textures more extended in polder. Using GPS in 2012 again soil samples were taken from almost identical points than in 2009. Soil samples for determined of physical and hydro-physical soil properties were taken from the depth 0.0 – 0.6 m from each 0.2 m. Four soil profiles were observed (profile 1 – profile 4). The granulometric composition was determined from disrupted samples for each soil profile and three depth of soil profile. Content of clay (< 0.002 mm), dust (0.002 – 0.05 mm) and sand (0.05 – 2.00 mm) were analysed by pipette analyse. Selected physical soil properties were determined from undisturbed soil samples in cylinders of 100 cm^3 from all soil profiles and depths. Physical soil properties were analysed as follows: bulk density (BD, in kg m^{-3}), total porosity (TP, in %), maximum capillary water capacity (MCWC, in %). These analytical methods were used [3]. Bulk density was determined by gravimetric method – weighting the soil after drying at 105° C to constant weight. Total porosity were determined by the equation

$$TP = [(SG - BD)/ SG] \times 100\ \% \qquad (2)$$

Specific gravity (SG, kg m^{-3}) was determined by pycnometric method. Maximum capillary water capacity was determined by gravimetric method. Data obtained from ground survey was tested by mathematical-statistical methods from which analysis of variance was used (the Statgraphic software package).

RESULTS AND DISCUSSION

Territory of polder Beša is non-regularly overflowing landscape area in eastern Slovakia. Polder Beša belong to three cadastral territories, namely Beša, Oborín and Ižkovce villages [19]. Polder boundaries are shown on Figure 1.
Extreme floods situation in Bodrog river catchment was formed from polder construction in year 1965 until now 7-times. Data of polder saturation and retention volumes are shown in Table 1. Maximum capacity of polder Beša is 53 million m^3 of water which has not yet been used.

Figure 1: Boundary of polder Beša

Table 1: The data of polder saturation

Data	Amount of water [million m^3]	Using of polder capacity [%]
October 1974	44.0	83.02
January 1979	30.2	56.98
July 1980	34.5	65.09
March 1999	30.2	56.98
April 2000	41.4	78.11
March 2006	11.0	20.75
May and June 2010	35.0	66.04

Dry polder Beša is characterized by heavy heterogeneity of soil parameters and so various soil textures alternating on short distances. The experimental soil profiles were taken by presence of soil textures and soil types, on bases of information from Research Institute of Pedology and Soil Conservation. The granulometric compositions of experimental profiles are shown in Table 2. The clay content reached interval 14.27 – 62.55 %. In year 2009 average content of clay, for all observed soil profile and depth 0.6 m, was determined on level 35.24 %. In year 2012 it was 38.93 %.
The content of dust was range from 25.04 % to 51.90 %. For all observed profiles and depth 0.6 m the average dust content was 41.75 % in year 2009 and 35.93 % in year 2012. The sand was found in interval 6.25 – 56.21 %. The average sand content was 23.01 % in year 2009 and in year 2012 it was 25.15 %. From these data influence, that after the overflowing polder area in year 2010, the clay content increasing in average by 3.69 % in year 2012 in comparison with year 2009, the dust content was decreasing in average by 5.82 % and the sand content was increasing in average by 2.14 %.
A determined change of granulometric fractions content wasn't statistically significant and it was confirmed by analysis of variant. From obtained data resulted, that non-regularly overflowing area of dry polder Beša effected also content of individual granulometric fractions in observed of soil profiles, but statistically significant change of granulometric composition wasn't determined.

Table 2: The granulometric composition of soils in polder Beša

Diameter of particles	Depth [m]	Year	Soil profile 1.	2.	3.	4.
< 0.002 mm clay	0.0 – 0.2	2009	13.11	20.98	47.67	30.98
		2012	14.66	32.61	31.52	58.01
	0.2 – 0.4	2009	14.54	27.44	42.47	48.97
		2012	18.00	28.87	46.14	64.21
	0.4 – 0.6	2009	15.15	34.02	56.45	71.05
		2012	23.59	37.06	46.99	65.45
0.02 – 0.05 mm dust	0.0 – 0.2	2009	32.61	51.29	39.70	60.00
		2012	27.50	43.38	54.24	32.89
	0.2 – 0.4	2009	33.83	55.78	39.43	45.07
		2012	26.23	53.16	41.81	20.38
	0.4 – 0.6	2009	35.48	48.63	33.98	25.17
		2012	21.39	44.82	39.00	26.31
0.05 – 2.00 mm sand	0.0 – 0.2	2009	54.28	27.73	12.63	9.02
		2012	57.84	24.01	14.24	9.10
	0.2 – 0.4	2009	51.63	16.78	18.10	5.96
		2012	55.77	17.97	12.05	15.41
	0.4 – 0.6	2009	49.37	17.35	9.57	3.78
		2012	55.02	18.12	14.01	8.24

The average content of individual granulometric fractions is shown on Figure 2. From data on this figure influenced [13] that after polder overflowing in year 2010, the soil in 1 profile was evaluated as sandy-loamy in year 2012, in year 2009 it was loamy till sandy-loamy soil. In 2nd profile the change of soil classification wasn't determined and in both compared years the soil was evaluated as clay-loamy till dusty-clay-loamy soil.

In year 2009 the soil in the 3 profile was clayey soil, but in year 2012 the soil was classified as dusty-clay soil. Similar, but opposite change in the evaluation of soil was determined for 4 profile, when in year 2009 the soil was dusty-clay, but in year 2012 it was clayey soil. Determined the changes of clay, dust and sand contents in soil profiles, suggested that really possibility of granulometric composition change by increasing of the water-tables of water flows for lowland areas and transport of soil matter on long distances by flood wave.

The bulk density is one from base physical soil properties. For soil with high content of clay particles has also very low value and it has connection also with water content in the soil profile. In the polder Beša the bulk density was in range from 1040 kg m^{-3} to 1787 kg m^{-3} (Table 3).

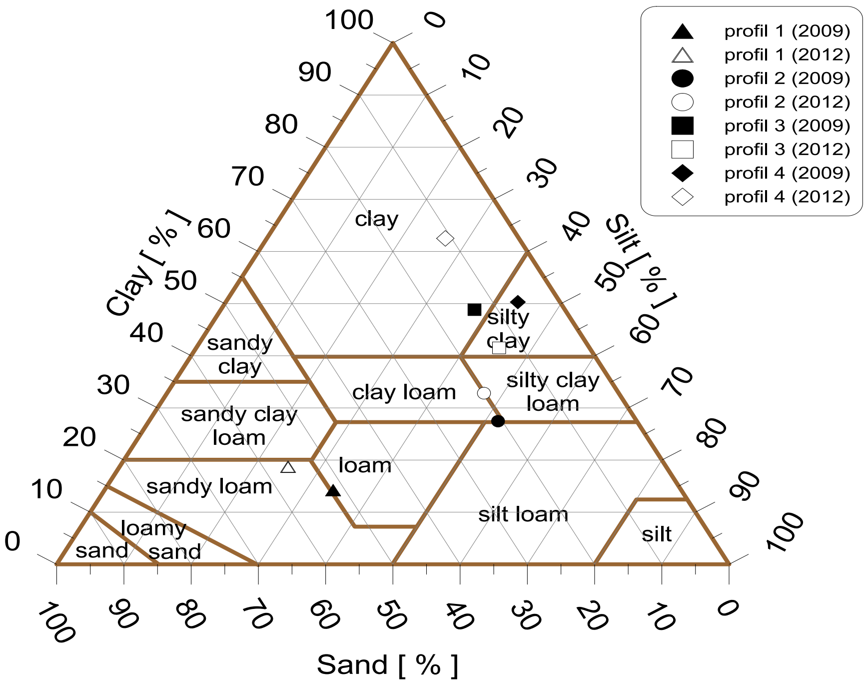

Figure 2: The representation of the granulometric categories by granulometric triangle

In the all observed depth and soil profiles, higher values of the bulk density by 16 till 122 kg m^{-3} were determined in year 2012 in comparison to year 2009. Obtained values were significantly lower for profiles with higher content of clay particles then in profile with sandy-loamy soil. The effect of the clay particles and crystallization skeleton of clay minerals on base the montmorillonit and illit with high ability of swelling and shrinkage processes was shown here. Similar results for soils of the East Slovak Lowland published for example [2], [3], [15]. In the polder Beša high spatial variability of the bulk density determined also [7]. The total porosity of soil is a function of the bulk density. The porosity in negative correlation correspond with the bulk density and it signify at lower bulk density the total porosity is higher and opposite. For the heavy soil the processes of the swelling and the shrinkage are characterised. Higher bulk density modifies the ratio between water and airy soil capacity in favour of water capacity, decrease total porosity and increase proportion of capillary pores [9]. The capillary pores underlie favourable water regime and supply the plant cover with water. The changes of pores space in profile of the heavy soils are occasionally more important than a process of saturation and discharging of soil pores by water. In case of drying of heavy soil the diameter of soil pores is growing smaller and so approach of roots of field crops to water is reduced. The total porosity in the polder Beša (Table 3) was determined in range from 32.79 % to 61.74 %. The average porosity in year 2009 was 49.42 % and in year 2012 it was 47.47 %, it was by 1.95 % lower. In all observed soil profiles the total porosity was lower in year 2012 in comparison with year 2009. The highest values for both compared years were determined for soil layer 0.0 – 0.2 m. Similar findings were published [12] and [13].

Amount of soil water, which on concrete post in definite part of vegetation is available for agricultural crops, is dependence except of meteorological conditions also from physical properties of soil [17]. The maximum capillary water capacity is important hydrophysical factor, which significantly influencing the production process. This soil parameter is closely connected with the content of clay particles in soil profile and with water storage in soil, too.

For the heavy soils with high content of clay particles is large interval of the maximum capillary water capacity typical [4].

Table 3: The physical properties of soil in polder Beša

Soil parameter	Depth [m]	Year	Soil profile			
			1.	2.	3.	4.
Bulk density [kg m^{-3}]	0.0 – 0.2	2009	1660	1104	1151	1040
		2012	1726	1160	1297	1158
	0.2 – 0.4	2009	1776	1277	1222	1106
		2012	1787	1271	1397	1212
	0.4 – 0.6	2009	1720	1409	1324	1195
		2012	1739	1406	1369	1245
Total porosity [%]	0.0 – 0.2	2009	36.82	57.42	56.09	61.74
		2012	35.08	56.06	50.87	56.50
	0.2 – 0.4	2009	32.86	51.19	52.82	58.35
		2012	32.79	52.27	46.99	54.50
	0.4 – 0.6	2009	34.73	46.52	49.69	54.83
		2012	34.93	47.30	49.03	53.30
Maximum capillary water capacity [%]	0.0 – 0.2	2009	35.35	45.09	48.09	50.94
		2012	29.65	48.28	43.30	51.40
	0.2 – 0.4	2009	31.16	42.97	48.85	55.09
		2012	26.88	44.43	43.18	50.10
	0.4 – 0.6	2009	31.14	37.32	45.20	50.95
		2012	28.12	42.28	42.78	51.80

The maximum capillary water capacity determined by Novák [11] approximately characterised the terrain conditions and it is possible this soil parameter consider to value of field capacity. Its values are lower than values of the absolutely water capacity and differences between field and absolutely water capacity decrease at higher content of clay particles in soil. The heavy soil, belong to also majority of soils in the polder Beša, by reason of high content of clay particles have great possibility to keep the water. The clay particles have the high ability of swelling at water receiving. The skeleton of clay soil minerals has however limited ability for expansion and it connects with volume of pores space in soil. Owing to the ability the heavy soils characterized by important volume changes and it in detail described [3], [11], [15], [16] and [18]. Also in the polder Beša the values of the maximum capillary water capacity were determined in large interval namely 26.88 – 55.09 %. The average decreasing of the maximum capillary water capacity in year 2012 by 1.66 % in comparison with year 2009 was statistically no-significant.

The effect of three factors (year, soil profile and depth – independent variables) on physical parameters of soils in polder Beša – dependently variables bulk density, total porosity and maximum capillary capacity – were valued by the statistical methods. The analysis of variance from the Statgraphic software package was used (Table 4).

Table 4: The analysis of variance of soil physical parameters

Source of variability	**Degree of freedom**	**F – calculated value**		
		Bulk density	**Total porosity**	**Maximum capillary water capacity**
year	1	41.28 ++	25.05++	12.73++
soil profile	3	623.35 ++	607.03++	369.15++
depth	2	64.93 ++	59.07++	12.33++
residual	86			P = 0.05++
total	95			

The statistically significant effect of year, soil profile and depth on all observed parameters of soils in polder Beša was confirmed. By F value calculated the soil profile had the highest effect on observed physical soil parameters.

CONCLUSIONS

The high spatial variability of the soil textures determined in year 2009 was confirmed also in year 2012 on the basis of made ground survey in the landscape area of the polder Beša.
The soil in the sampled profile by the granulometric composition analysed in year 2012 is characterized as sandy-loamy soil (1. profile), clay-loamy (2. profile), dusty-clay (3. profile) and clayey (4. profile). From comparison of granulometric composition, result statistically no-significant change for soils in the polder Beša.
The overflowing of the polder Beša in year 2010 contributes for increasing of the bulk density and decreasing of the total porosity in year 2012 in comparison with year 2009. Increasing of the bulk density by 65 kg m-3 and decreasing of the total porosity by 1.95 % indicate degradation of water-air portions of soil in polder and so also decreasing of accumulation and transport functions of soils.
On the base of preliminary results may be assumption the negative changes of the physical soil properties after the overflowing the service area. Development of the granulometric composition and physical properties of soils in the polder Beša will be subject of further study.

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ENVIRONMENTAL IMPACT OF MINING

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Abstract: *This paper deals with the impact of mining on the environment. Coal mining is still among the most widespread and most intense mining activity, which disturbs the landscape around us. For many countries, including the Czech republic, deposits of raw materials play an important role, especially for purposes of producing electricity and thermal energy. Part sof these problem are: the monitoring, environmental impacts assesment of exploration and mining activities and waste disposal mining, which may significantly contribute to the environmental protection in the future.*

Keywords: *mining, environmental monitoring, environmental impact, landfill mining.*

INTRODUCTION

Mining is a profession dealing with geological exploration, development work, mineral deposit mining, preparation of minerals, relevant construction as well as effacing of negative environmental impacts. Mining methods can be classified as:

- opencast (carried out in opencast quarries),
- underground (carried out in underground mines),
- others (e.g. geotechnological mining methods – chemical, bacterial leaching, etc.).

In terms of mineral deposit mining we distinguish coal, ore and industrial mineral (non-ore) mining. The extraction of mineral resources is closely connected with negative environmental impacts. The manner and intensity of impact on the landscape depends on:

- the type of extracted raw material,
- mining method and its intensity,
- concentration of mining operations on a certain territory,
- geological conditions of deposit formation,
- morphology of the affected territories.

Coal mining is the most widespread and most intense mining activity that disturbs the landscape. In many countries, including the Czech Republic, deposits of energetic raw materials play an important role as power and heat generation is largely dependent on them. In the Czech Republic, negative impacts of coal mining may be observed in Podkrušnohoří and the Ostrava Region. Figures 1 and 2 show the coalfields of the Czech Republic.
All major components of the natural environment are usually affected, such as soil, water and air. At the same time, especially in the localities with concentrated mining (e.g. Karviná part of the Ostrava-Karviná District - OKR) the landscape is affected as a whole and the so-called mining landscape originates. There are prominent changes in geomorphology, soil fund, greenery, atmosphere, hydrogeology and other biotic constituents of the landscape.
Soil is influenced in the most intense way, water is less affected and air comes last. Manifestations and impacts of opencast mining are completely different.

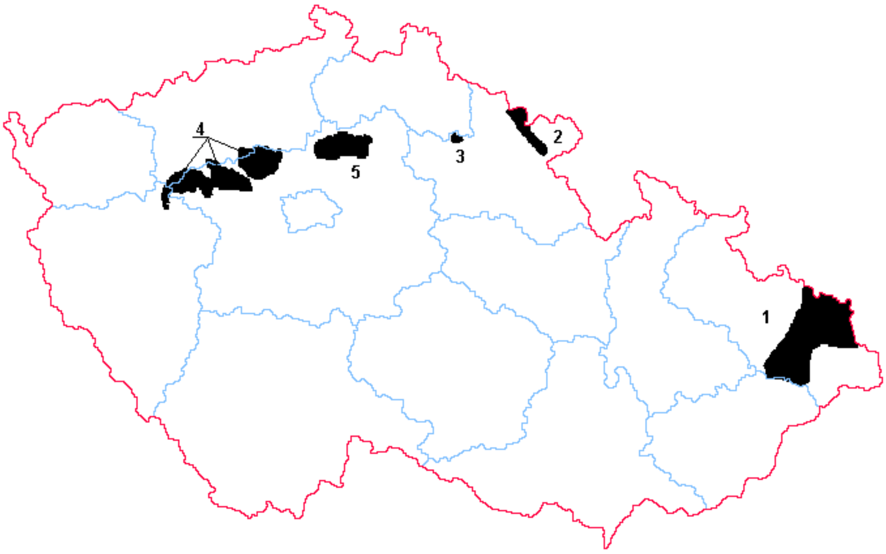

Fig. 1: Black coal fields in the Czech Republic:
1. Upper-Silesian – 1600 km^2 (predominantly in Poland), the only territory of current mining, 2. Inner-Sudetic – mined out, no more economic, 3. Lower Giant Mountains – low-quality coal, inperspective, 4. Central-Bohemian – mined out, no more economic, 5. Mělník – no more economic, inperspective

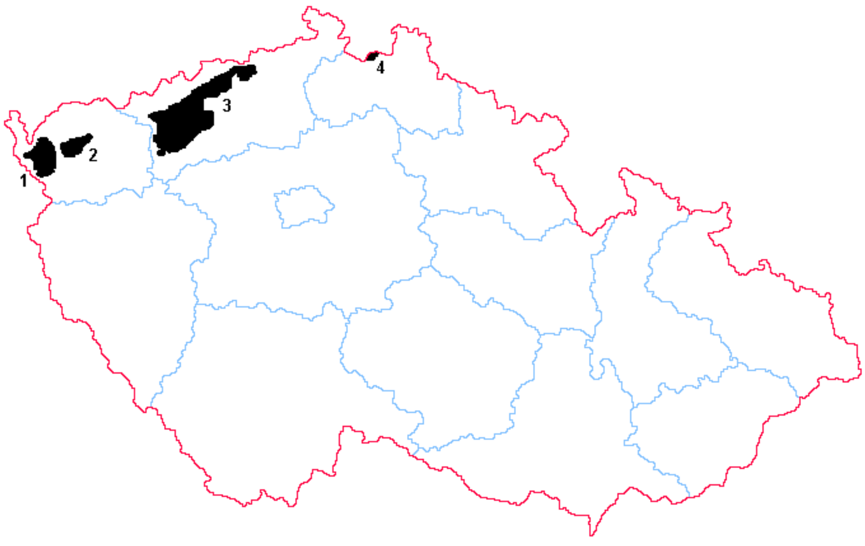

Fig. 2: Brown coal fields in the Czech Republic:
1. Cheb – it is not exploited with regard to the spa mineral water of Františkovy Lázně, 2. Sokolov – 25 % mining, 3. North-Bohemian – 3 parts (Chomutov, Most, Teplice), 75 % mining, opencast mining, 4. Žitavská – it is not exploited due to economic and technical reasons

Underground Mining

Underground mining of mineral resources is manifested on the surface in the form of two characteristic elements, such as refuse dumps (waste rock) and movements and

deformations caused by undermining. Refuse dumps influence the landscape and the environment in the negative way in many respects. They are atypical geomorphological formations in the landscape, especially when conical dumps are concerned. They are also the source of dustiness, both primary and secondary. In certain cases, when their ignition occurs they are sources of waste products polluting the atmosphere further afield. Dumps also usually take up fertile land. Their decontamination and reclamation is difficult, and depends on the shape and dimensions of the dump.
The second typical element is movements and ground deformations caused by undermining. Movements of the undermined territory cause the following:

- substantial, long-term and spatially extensive destruction of the relief, landscape, residences, underground services, roads, in the sites of subsidence basins hazardous disposal sites of industrial and municipal waste are concentrated,
- irreversible changes in ground and surface water, formation of drainless inundated subsidence basins, changes in the courses of rivers and streams and their falls of stream, changes in the catchment ratios in the sewage systems,
- damage and destruction to the soil profile.

The impacts of undermining

The overall extent of undermining impacts depends on, in particular:

- intensity and character of mining impacts,
- ground morphology,
- structure, type and character of premises, facilities and soils found in the mining landscape.

Undermining shows in the long-term and, to a certain extent, cyclically. The cycle of the manifestations of undermining can be divided into three stages as for biotic action, according to Smolík, as shown in Table 1.
Undermining is manifested both by the movement of rock massif in the surroundings of the worked out space and the rock massif in the main roof, as well as by the movement all the way to the ground, i.e. having an effect on the morphology of landscape.

Table 1: Stages of the effect of undermining on the environment

Stages	Type	Environmental components	Manifestations
1	impacts of undermining	rock massif and landscape relief	subsidence, movements, delevelling, curvature, proportional horizontal deformations, discontinuous deformations, etc.
2	consequences of impacts of undermining	landscape and its constituents (anthropogenic sphere, pedosphere and hydrosphere)	subsidence, lifting, shifting, expansion, compacting, tilting, change in the gradient, waterlogging, flooding, degradation, devastation, etc.
3	removal and effacement of the consequences of undermining	landscape and its constituents	repairs, decontamination, reclamation, regeneration, liquidation, demolition

The manifestations of undermining on the landscape morphology can be diverse. Basically, they are divided into continuous and discontinuous deformations.
The character of earth ground deformation predominantly depends on a number of factors that can be classified as follows:

- geological factors (geological structure, degree of tectonic ruptures, hydrogeological conditions),
- geomechanical factors (geomechanical properties of rocks),
- spatial factors (depth of mining, deposit dip, shape and dimensions of the worked out space, deposit thickness, landscape morphology),
- operating factors (technology of mining, filling method of the worked out space, failure to the roof due to earlier winning operations),
- time factors (formation rate of area of extraction, rate of overburden subsidence).

Continuous deformations are characterized by gradual formation of a continuous subsidence basin, the shape of which is usually given by the dip of the worked deposit (inclined and steep dip) and the depth of extraction.
Discontinuous deformations of the ground are characterized by exceeding the soil or rock strength. Among the forms of discontinuous deformations there are – ground degree, cracks, ground roll, earth fall and downthrows. Discontinuous deformations of the ground are accompanied by structural changes in the foundation soil the tensile, compression and shearing strength of which is exceeded. Discontinuous deformations of the ground usually form very fast, which on the other hand does not permit the use of rheological characteristics of building materials or foundation soils. For premises on undermined territories, discontinuous deformations are more dangerous than the continuous ones. Their influence of the landscape morphology is destructive.
Therefore, periodic measuring is carried out in undermined territories. Movements and deformations are measured in observations bases which are stabilized both in the terrain as well as in sensitive premises and facilities in the mining landscape.
Among the main environmental impacts of underground mining there are:

- dumps (dustiness, burning, washing away of sulphur),
- mining areas (gas bursts, ventilation outlets, etc.),
- concentration of industrial and municipal waste disposal sites,
- irreversible changes in water regime – formation of drainless areas,
- damage and destruction to the soil profile.

Opencast Mining

Among the major consequences of opencast quarrying of mineral resources for the environment there are:

- long-term and frequently irreversibly claimed land with high-quality agricultural and forestry soils that are locally accompanied by devastation of rare wetland ecosystems with protected species of flora and fauna,
- changes in the landscape relief, including dumps, clearance, interfering neologisms are formed, exceptionally complete devace are removed – landscape dominants,
- threat to the drinking water reserves bound onto the rock formations with all negative manifestations (contamination, reduction in the ground water level, interference with the natural circulation),
- formation of water areas that may locally cause irreversible microclimatic changes,
- the surroundings of mining operations are strained with increased noise levels and dustiness (e.g. the effects of blasting, transport of raw materials),

- development of related industry – power engineering, chemical industry.

ENVIRONMENTAL ISSUES OF DEPOSIT EXPLORATION, MINING AND ITS TERMINATION

Geological conditions and processes condition the character of the anthroposphere to a great extent, where the effects of mutual action of the geosphere, hydrosphere, atmosphere and biosphere with human activities present. Therefore, for a number of years the so-called environmental geofactors have been monitored and evaluated in the form of special maps, among which there are mineral resource deposits, ground water sources including such for medical purposes, geotechnical and geochemical characteristics of the environment, soil conditions, geodynamic phenomena, etc., i.e. factors that are important in providing for the human material needs and in the formation of the environment. In this respect, a geological exploration has a cognitive, appraising and informative function. Deposit exploration and especially consecutive extraction and modification of the discovered deposits of mineral resources may have a range of impacts on the natural, social and economic environment. In the sphere of the natural environment it predominantly influences the rock environment as well as other constituents of the environment (hydrosphere, atmosphere and biosphere). The movement of masses connected with the extraction is huge and in its extent it significantly exceeds the share of natural processes. Thus, a lot of attention has been paid to monitoring and evaluation of environmental impacts of mineral resource industrial activities. However, it must be emphasized that the impact of mining plant activities has a local or maximally regional character only, as for the affected area of a region or state, for example, it is practically negligible. For instance, between 1930 and 1980 mere 0.25 % of the overall area of the USA was used for opencast mining, dumps of opencast and underground mines and waste disposal sites from preparation plants. All mines for non-ferrous metals take up only 0.02 % of the area. Concurrently, approximately 47 % of the area affected by mining and waste dumps was reclaimed as per the end of the stated period (Johnson et Paone in Ostensson 1997). In Australia the area affected with mining activities concerns a completely negligible number of 0.001 %. With no doubt, there are other activities with much more extensive and serious impacts, such as power-engineering, automobile transport, agriculture or timber cutting in tropical rain forests (Table 2). Nevertheless, e.g. deposit territories of opencast mining of coal, iron or porphyry copper ores deserve some attention.

Table 2: Human activities and possible environmental impacts

Sphere of activities	Possible environmental impacts	Extent of impacts
power-engineering	pollution of air, water and soil, thermal effects, damage to the biosphere, agricultural and forestry land required	regional to global
agriculture and forestry	erosion, landslides, salting of soil, floods, pollution and changes in the water regime, influenced biosphere	regional to global
transport and waterworks	landslides, rock falls, earthflows, subsidence, floods, changes in the ground water levels, influenced biosphere, land required	regional
industrial production	pollution of air, water and soil, noise, vibration, damage to the biosphere	local to regional
mining	changes in the landscape morphology, subsidence, landslides, reduction in the ground water levels, pollution of air, water and soil, concussions, noise and vibrations,	local to regional

	damage to the biosphere, land required	
housing development	changes in the landscape morphology, pollution of air, water and soil, thermal effects, noise, influenced biosphere, land required	local to regional
tourism	pollution of water and soil, soil erosion, damage to the biosphere	local to regional
waste disposal	pollution of air, water and soil, impact to the underlying rocks, thermal effects, land required	local
transport	pollution of air and water, noise and vibrations, influenced biosphere	global
waterworks engineering	impacted water regime, changes in the landscape morphology, subsidence	local
geological exploration	possible impact to the water regime and polluted water sources	local

It is apparent that the own geological exploration does not represent great danger for the environment. Both the impacts of the applied procedures are minimal as well as the valid regulations require disposal of the incurred interference with the environment immediately after work termination. More prominent are the impacts of mining activities that must be analyzed already within the survey. A part of the final report or the feasibility study of the mining plan must incorporate an assessment of expected impacts on all the environmental components and suggestions for their minimization and consequent disposal within termination work. During analyses, apart from the physical environment, the economic environment must also be respected, which has a comparable significance in assessing an exploratory and mining plan at least.

ENVIRONMENTAL IMPACT ASSESSMENT – EIA

The process of assessing the impacts of exploratory and mining activities plays a positive role in the plan preparation. It makes part of the system of preventive tools of environmental protection and it appropriately complements the mining legislation. In its consequence, it leads to the minimization of financial costs for the programme implementation and related environmental measures. The introduced system of public hearing, which makes part of the assessment process, eliminates possible conflicts with the public. The screening process that is being introduced shall even improve the situation as the public will be involved in the assessment process already in the initial stage of the process.
The term of EIA - Environmental Impact Assessment - is grounded in *National Environmental Policy Act* of 1969 in the environmental domain, division 102.
This act brought a radical change as in the form of an Environmental Impact Statement (EIS), for the first time ever, a proposer of activity is obliged to prove that they will not significantly affect the environment.
The European Economic Commission stated in the Second Environmental Action Programme of 1977 that EIA is a requisite tool of environmental care. After numerous negotiations, in 1985 European Community Council Directive 85/337 was negotiated on environmental impact assessment of certain private and public projects. The next important step was EEC convention acceptance on environmental impact assessment exceeding the national borders in 1991 (the so-called *Espoo*). The individual countries applied EEC Directive 85/1985 in three forms. Some countries incorporated the issue of EIA into the existing legal norms, usually as amendments on land-use planning (Great Britain, Ireland,

Denmark) or acts on conservation of nature (France). In other countries EIA became part of acts on the environment (Netherlands, Greece). At last, some countries adopted separate legal norms on EIA (Germany, Belgium, Spain, Czech Republic and further to the provisions of the environmental law).

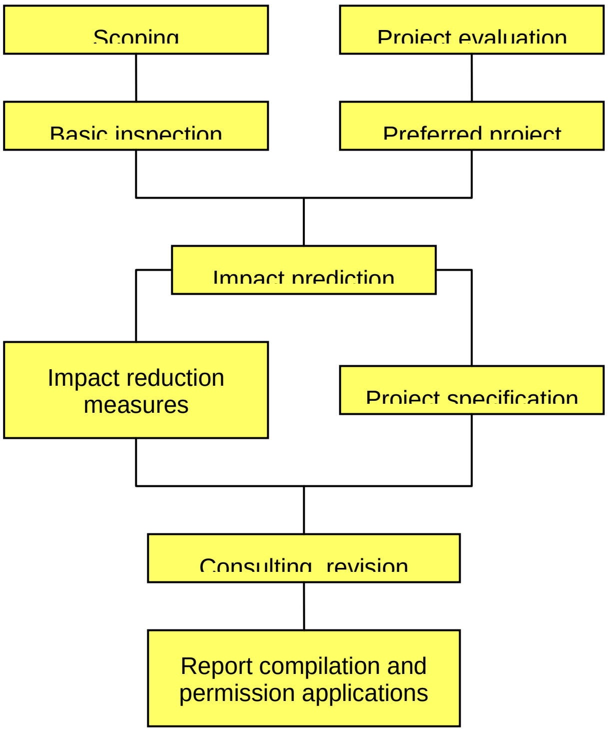

Fig. 3: Chart of EIA process, according to SRK Ltd.

Currently, assessment of constructions, activities and technologies, assessment of development concepts and programmes and assessment of products is under way. Procedures and required particulars differ in the individual groups. Projects are assessed in terms of ecological acceptability of the territory in question, consequences of the activities and possible accidents, cumulative and synergic phenomena, prevention and minimization of project's environmental impacts, disposal method of products after their expiration or utilization (possible recycling and disposal), applied assessment methods and comprehensiveness of information. At the same time, a comparison with best available technologies is also required.

Along with the progress in the environmental legislation and requirements for ever stricter standards, environmental research is becoming a basic element of planning exploratory and mining programmes. It is ideal to start such work already in the initial stages of the project preparation in order to prevent incorporation of such activities which would lead to complications or fatal events or unsolvable conflicts of interest. The first stage of the task, which is compulsory in certain countries, is scoping as a precondition of development acceptability for the approving agencies and investors. The following stage of study and assessment of impacts and proposals of possible solutions arise in the mutual co-operation of an engineering and environmental team (Fig. 3).

As stated above, the programmes of deposit exploration do not have significant impacts on the environment. The majority of geological, geophysical and geochemical methods are non-destructive in their character. A certain impact is caused by the application of technical exploratory work connected with construction of access roads and workplaces, which may lead to damage on forest plantations and farm land. The use of drilling and underground mining work may influence water conditions due to discharge of mud and leaks of oil products. The circumstances are usually regulated by mining law that sets the duty of land reinstatement (if objectively and economically possible) and duty of surface exploratory work disposal and mine working securing. Exploratory programmes are also bound to relevant permits that may include implementation conditions in terms of environmental protection. Within exploratory programmes it is also necessary to follow another part of environmental protection, namely in terms of the final effect. It is not effective to implement exploratory work the results of which will not be applicable due to the environmental protection (e.g. deposits of building stone or gravel sand).

Environmental impact assessment is required for all activities connected with the exploitation of mineral resource deposits as they concern land, water sources, ecological systems, cultural and protected reserves and features as well as the whole public. Within the assessment, attention must be paid to the applied mining technologies as for their safety and degree of environmental impact. Highly effective technologies are preferred, minimizing the production of waste and improving the culture and sanity of miners' work. The main problem of opencast mining is the land required, impacted constructions of all types, surface water courses and reservoirs, road connections, energy and product distribution systems, undesirable changes in ground morphology disturbing the original skyline, etc. In underground mining, apart from land required, what is greatly negative is the impacts of undermining that may manifest through ground subsidence, damage to surficial structures and facilities, changes in the ground and surface water regimes including the influence to their chemism, etc. Out of the above stated, monitoring system preparation and continuous remediation of waterlogged subsidence basins is required already in the preparation stage. Moreover, in both cases attention must be paid to volume of traffic in the territory which may, in some cases, show as limiting for mining activities. At last, the issue of air pollution caused by dust from traffic, preparation plants, dumps and settling basins as well as the issue of increased noise and concussions connected with blasting cannot be neglected. It is also vital to assess the possibility and probability of critical situation occurrence, such as fire or shock bumps. Another important aspect of the assessment is the requirement for continuous expert biological monitoring of the locality (assessment of species diversity of the locality, assessment of ecosystem resistance to increasing strain, etc.), operative elimination of mining activity impacts on the ground in order to protect the fauna and flora, and provide replacement plantation in the affected sites.
The procedural environmental impact assessment process may differ in details. Table 3 shows an example of detail arrangement of EIA process in the Czech Republic.

Table 3: EIA Chart, according to CNR Act 244/1992 Coll.

Activity	**Activity required**	**Arranged by**	**Recipient**	**Deadline**
PLAN	plan prepared	investor	relevant authority	
DOCUMENTATION	documentation processed	authorized person		
HANDOVER	sending of plan and documentation	investor	relevant authority	
	documentation sent to the relevant municipality and authorities in question	relevant authority	relevant municipality, authorities in question	5 days
PUBLIC CONSULTATION	announcement on possible consultation	relevant municipality	citizens	5 days
	public consultation	citizens	relevant municipality	30 days
STATEMENT	written comments and statement	relevant municipality	relevant authority	14 days
	statement to the documentation	authorities in question	relevant authority	50 days
EXPERT OPINION	arrangement of expert	relevant	authorized	

	opinion processing	authority	person	
	expert opinion processed	authorized person	relevant authority	60 days
PUBLIC HEARING	public hearing	relevant authority		30 days
	report compiled	relevant authority		
OPINION	opinion issued	relevant authority	investor	

Note: according to the plan character, the relevant authority is a local authority or the Ministry of the Environment of the CR, the authority in question is a state administration body of the concerned field of activity

At present, world-wide attention is paid to *environmental impact assessment on the level of development concepts*. This trend is very meaningful as acceptance of a certain concept has direct consequences for the implementation of follow-up projects, in the majority of cases.
For example, the concept of industrial policy of wording the basic development trends determines the types of vital raw material sources. The concept of raw material policy anticipates the focus of deposit exploration and extraction of mineral resources, or other methods of their acquisition (e.g. by means of import or through foreign co-operation). The concept of traffic policy may have an impact on the sphere of exploration and mining as the future development of roads requires provision of necessary sources of building stone and gravel sand.
A part of assessment of project construction and mining plant operation is also the evaluation of a project of their abandonment and follow-up reclamation of the territory in question (Table 4). This part of assessment is very important as ill-conceived and objectively and financially unsecured projects may lead to consequent complications when the final arrangement of necessary work becomes the concern of public authorities. The existing mining laws or related environmental regulations fully control this sphere and impose the duty to create vital financial resources.

Table 4: Typical plan of mine abandonment (Ricks 1997)

Activities	**Years before and after mining activity termination**												
	planning of mine closure					closure	active care				passive care		termination
	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8
planned mine closure													
plan revision and updating													
plan approval by authorities													
contract preparation													
underground facilities													
dismantling of built-in equipment													
waterworks closure													
superficial facilities													
dismantling of built-in equipment													
housebreaking													
removal of infrastructure													
utilization/dumping of all materials													
water management													
drainage construction if necessary													
monitoring of surface													

discharge
monitoring of mine inundation
monitoring of mine water outflow
construction of settling pit drainage
monitoring of settling pit outflow
remediation of the territory
ground development
ground preparation for greenery
seeding and planting trees
research in settling pit reclamation
settling pit reclamation tests
settling pit greenery planting
plant cover care
monitoring of plant growth
socio-economic issues
identification of alternative investments
consultancy for job winning
termination
▪ final report compilation
▪ public release
▪ territory vacated

From the conceptual point of view, reclamation work is divided into several successive phases (Smolík in Dirner et a1. 1997):

- preparatory phase with its predominantly preventive and optimization function; it is grounded in the co-ordination of utilization of a raw material source and dealing with possible conflicts of interest,
- mining-technical phase when attention must be focused on minimization of mining impacts and controlled shaping of the devastated territory, especially through suitable placement of dumps and disposal sites, suitable shaping of the ground, etc.,
- biotechnical phase which, through work of technical and biological character, modifies and improves ecological characteristics of a locality according to a chosen type of land reclamation (agricultural, forestry, orchard-park, water-management, recreational),
- post-reclamation phase initiated with handing over the reclaimed land for further use.

The procedure of *EnTA - Environmental Technology Assessment* – designed by UNEP IE, is well applicable for the environmental assessment of mining technologies (Figure 4).

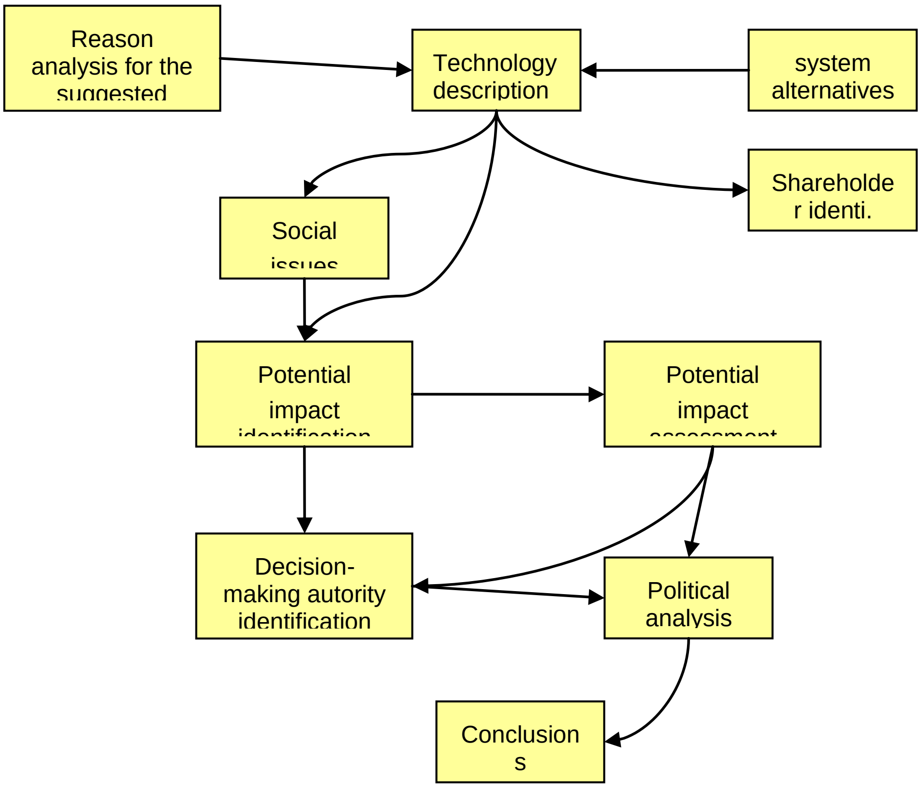

Figure 4: Chart of environmental assessment of mining technologies, according to UNEP IE (1997)

REFUSE FROM MINING AND PREPARATION

One of the main environmental impacts of mining and coal preparation, in particular, are settling pits for coal slurries. Settling pits cause extensive contamination of soils by toxic metals and organic pollutants, unfavourably influence the rock environment including the quality of surface and ground water, and embody vast disposal sites of coal slurries. Their combustion then causes air pollution. Air pollution is also brought about by burning of dumps.

DISPOSAL MINING

In terms of possible reliable and relatively effective disposal of certain types of waste materials, underground mining gains another significant function, i.e. waste dumping and thus it is labelled as waste disposal mining.

Characteristics of waste disposal mining

In the future, waste disposal mining may significantly contribute to the environmental protection. Preferred must be benefication of waste both from mining as well as from other industrial branches for the mining purposes. This is possible in the form of building and filling materials to be used in mining. With an ever increasing need of building materials underground, this way it is possible to make use of the material advantages in the sphere of

safety, rock mechanics and reinforcing technologies with long-term safe disposal of industrial refuse underground.
In addition, in the long-term, waste disposal containing toxic and radioactive harmful substances may be realized in suitable rock formations below the ground. Long-term safety is guaranteed by a geological and technical system of multiple barriers. Disposal or dumping may also be carried out with the option of a repeated use, or without it, namely in conveniently fitted cavities, chambers, cavern and deep wells.
In underground deposit mining worked our space is formed underground which, for certain reasons, particularly safety ones, is filled spontaneously (surrounding rock caving) or backfilled with other material.
In larger scales, the use of backfill is nowadays mainly required by safety and ecological causes. Mining and non-mining waste is used as backfill material. Backfilling the worked out or other free space in underground mining of mineral resources offers advantages independent of economy, both in terms of safety (reaching more efficient ventilation and more favourable climatic conditions) as well as ecology (protection of surficial and landscape structures). Advantages even multiply if waste disposal is possible this way, which would otherwise cause problems in the environmental sphere. This again raises an idea of creating and using underground space for this purpose – to dispose of harmful substances.
In mining the issue of waste disposal is continuously growing on importance, namely in the way the classical backfilling of worked out space is completed with utilization and follow-up dumping of ecologically unsound waste in the existing underground space, or underground space specially established for the purposes. If waste disposal through backfilling is the basic and only reason of mining, new aspects, tasks and problems appear there.

Reasons and preconditions for underground waste disposal

The current situation of waste production, of hazardous waste in particular, is alarming in the production, social and consumers' spheres of the Czech Republic. This unfavourable situation, mainly in respect to immediate possible changes in own production technologies that would lead to a radical turn in waste management (volume minimization, recycling, secondary utilization, etc.), demands an immediate search for paths how to limit or exclude contact of already generated and ongoingly formed waste.
The today's economic perspective and economic policies are unfavourable for dealing with waste issues and the only hopeful process may be a very economical and financially undemanding one in the near future. This logically ensues a possible solution only for some, let's say, simpler and easier problems of waste management.
There are sufficient reliable and verified details, gained through long-term geological-exploratory and mining activities, on the fact that that within the Czech Republic there are territories with suitable conditions. It may be an effective solution of a basic problem in the given space and time, i.e. construction of ecologically suitable disposal sites of regular and hazardous waste in appropriate geological, hydrogeological and geotechnical conditions making use of existing capacities or abandoned underground mines.
This way operation of underground disposal sites shall be possible on current world-wide level as a prospective activity in the mining business. This procedure is characterized by current requirements and expected results in the future:

a) Favourable rock environment is the most effective safety barrier, object placement underground practically excludes an access of unauthorized personnel and action of surficial effects (changes in temperatures, solar radiation, high precipitation, etc.).
b) Conversion of selected mining capacities into long-term disposal site operation, prospectively long-term waste disposal sites underground value up already expended

and largely written-off investments if main development mine workings, roads and facilities, energetic, filling and ventilation systems are concerned.

c) Activities in the rock environment are a specialized profession for a narrow circle of workers with formed habits for staying and working underground. Nowadays, mining and underground construction have available suitable technical means and technologies to create new space in the rock massif without excessive disruption of the rocks in the surrounding breaking.
d) Construction and operation of underground storage and disposal sites maintains jobs for specialized professions and skilled workers.
e) Transition from extraction to waste disposal mining is time less demanding than construction of new premises on the ground. Construction and operation of disposal sites making use of existing capacities does not make demands on land required on the ground, does not require construction of new power and media supplies, building of new roads, does not strain the environment by other unfavourable impacts such as noise, dustiness, etc.

One of the steps leading to system, technically well-arranged and safe procedure in design, establishing and operation of underground disposal sites of various types of waste is processing of fundamental technical conditions for waste dumping underground, such as standards that must have the following targets:

1) to determine a uniform framework to deal with specific cases and ensure complexness of solutions,
2) to ensure system approach to set up and operate waste disposal sites underground,
3) to create basis for processing normative documentation of a higher degree,
4) to provide professional and lay public with proofs on reliability and safety of the suggested structures and facilities for waste dumping underground,
5) to elaborate and introduce effective tools for environmental protection (audits, assessment methodology, etc.).

Conceptual approach to dealing with underground waste disposal issue

Apart others, an approach to utilization of underground space depends on the fact which mine space can be taken into account and what type of waste will be dumped there. In principle, the extent of utilization includes areas from separate sections of active mines, via abandoned mining plants to new disposal site operations. Naturally, costs increase respectively. As the need of new underground space for waste disposal will be great, it is requisite to state several comments on the concept of new space formation and the own waste disposal technology, to start with. Above all, construction of waste disposal sites underground must be implemented taking into account long-term safety and not the quantity of dumped material.

Therefore, the aspect of optimal geometric parameters of mine workings has a great significance for the disposal process. A solution depends on the considered type of waste disposal area, waste structure and dumping method. The type of disposal area is determined by the fact whether the disposal site is established for repeated utilization of the waste or without it. Only solid or reinforceable loose materials and slurry waste should be used for dumping.

The dumping technology depends on waste processing, namely by pumping, bulking or stacking for unprocessed, modified or packed waste. Currently, for example in Germany they are in the stage of trial runs or operations of such underground disposal site types: chambers of salt mines, horizontal mine workings and suitably modified wells.

ASSESSMENT OF NATURAL CONDITIONS FOR WASTE DISPOSAL MINING

Natural conditions include geological structure and massif structure, hydrogeological conditions and geomechanical assessment of selected rock positions or the individual rock types with respect to primary massif stress-deformation state and the state brought about by mining activities. Other factors are also important: petrographic composition, stage of diagenesis and physical- mechanical properties of rocks.

Geological structure of the massif

In terms of geology, goal-directed and careful attention must be paid to the issue of waste dumping – it is the case of basic questions on the massif structure as a whole, structure and position of specific rock positions (positions of water-bearing horizons and positions of stratification insulants) and tectonic conditions. As for overall mode of deposition an important factor is the depth of deposit placement or position where waste disposal site will be situated. Geological environment acts as an effective barrier against the spread of contaminants and isolates such substances from the biosphere.
The effectiveness of the geological environment is given by the ability to prevent the flow of ground water in the disposal site vicinity and to reduce possible migration to minimum this way. The geological structure predetermines the geochemical conditions in the disposal site vicinity and conditions the hydrogeological regime, including the ground water quality. Ground water may contain certain elements, in dependence on the rock petrographic composition, stimulating corrosion of packing materials or support other processes.
For assessment, tectonic conditions are very important as they significantly influence the hydrogeological regime of the rock massif and determine the initial character of primary massif stress-deformation state.

Hydrogeological conditions

The study of hydrogeological conditions is one of the basic preconditions of underground dumping solution. For example, in the Ostrava-Karviná District in the superincumbent and coal measures several water-bearing horizons exist that may be with gas zones (CH_4, CO_2). In principle, it is the case of a water-bearing subterranean horizon in the Quaternary, two to three water-bearing sandy horizons in the Tertiary containing mineralized confined water, water-bearing horizon of basal clastics on the boundary of the Tertiary and Carboniferous, called the Ostrava-Karviná detritus, manifesting various thicknesses and depths of occurrence, water-bearing zones and crevisse water in the Carboniferous contains mainly mineralized water of various composition and tension.
An operated mine shows water inflows which must be constantly drawn off. Apart from the mentioned sources, process water is also meaningful.
When a mine is in operation, the so-called steady water inflow is formed all the time. Due to permanent changes in workplaces in mine workings water inflow into a mine may considerably vary especially transferring into other areas. The situation is different when a mine is to be abandoned.
In the final stage of mine abandonment, having stopped pumping, gradual inundation of the worked space occurs. These are in particular, cross drifts, roads, spatial mine workings (depot, engine halls, power transformation substations, engine depots, etc.) and old workings. The rate of inundation and water rise depend on the quantity of inflowing water, volume of the free space in the mine and its horizontal and vertical distribution. Water inflow into a mine can be quite reliably determined from operation documentation. It is more difficult

with estimating the volume of inaccessible flooded space. Long mine workings, whose total length reaches several hundred kilometres, are more or less suppressed or caved, old workings in the worked out sections are filled with caved broken rock or backfill. The volume of free space to be filled with water can be determined only roughly and thus also the estimated course of inundation, in particular a rise of water level can fluctuate a lot.

Petrographic composition, physical and mechanical properties of rocks

Both in the enclosing rock as well as coal mass compression strength, mass density and bulk density, porosity, modulus of elasticity, total elastic energy and speed of ultrasonics spread are identified.

Geomechanical assessment of the massif

Deformation and disruption of the rock massif in mining activities depend on the geological structure of the massif, including the structurally geological structure of the massif and petrographic composition of rocks, physical-mechanical properties of rocks, primary stress field given predominantly by a gravitational field and field of primary tectonic stress and finally, secondary induced stress field forming through rearrangement of primary stress due to mining activities. The individual factors form separate units with it, but they are also mutually interrelated and influence one another. For instance, primary stress fields are affected by both the geological structure as well as by physical and mechanical properties of rocks.
Mechanical properties of rocks depend on their petrographic structure, age (consolidation), structure and other geological factors. In the end, also induced stress fields are a function of not only distribution of mine workings in time and space but of the geological structure and mechanical properties as well.
Dealing with the issues of deformation and disruption of the massif it is necessary to build on a detailed geological cognition of the territory in question, physical and mechanical properties of rocks and assessment of primary and secondary stress fields and their changes in the interest part of the massif.

Evaluation of geochemical conditions

The locality must be assessed in terms of geochemistry. It is vital to take into account the issue of geochemical stability of water-air-rock phase interface, i.e. parameters affecting the rate of rock environment weathering, type of secondary transformations, sorptive capacities, and functions of geochemical barriers. Interactions between the identified rock types, water types and expected waste material must also be considered.
An analysis of dissolution of loose and crushed material in an enclosed system is carried out and next, an identical process in the flow through system is monitored. The surroundings of the prepared disposal site may be strained thermally. An idea of reaction of the rock massif on the thermal changes can be obtained from the so-called thermal test. A very important value to assess the stability of the disposal site is a detail on the rock massif stress-deformation state and its changes in time.

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THE SUSTAINABILITY OF THE ELV RECYCLING SYSTEM IN THE REPUBLIC OF SERBIA

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Abstract: *The vast variety of materials is generated through the end-of-life vehicle (ELV) recycling processes. In order to make a system sustainable it is needed to obtain its economical, ecological, legislative, technical, national and regional sustainability. The economical sustainability of the ELV recycling system depends on the development of the repaired second-hand spare parts market, stock market prices of the recycled materials, national legislation and the government stimulus packages for this industrial branch. In order to create a sustainable system the ecological factors have to be considered. We have focused on the importance of the depollution process and its proper implementation with the suitable equipment. The Republic of Serbia as a country that tends to join the European Union, has to harmonize the national legislation acts with the European ones and to implement them and to implement them as well. This paper treats the influence of these factors on the ELV recycling system in Serbia.*

Keywords: *End-of-Life Vehicle (ELV), vulnerability, recycling*

1 INTRODUCTION

One of the pillars of the modern society development is the constant improvement of recycling industry. One of the major branches in the recycling industry is the one that deals with End-of-Life Vehicles (ELVs), due to the vast differences of treated materials in terms of amount and types as well. It is also significant due to the potential negative influences on the environment. Because of its importance it is needed to create a general approach to the ELV recycling problem, which could lead toward the long-lasting self-sustainable recycling system. The model has to be based on the real data which will contain relevant economic, legislative, ecological, technological and parameters of the regional networking in order to obtain its sustainability. Looking form the techno-economic aspect the main obstacles in creating a sustainable ELV recycling system are the mutual bounds between the number of generated ELVs, input/output price variations and environmental policy changes manifested through changes in national stimulus packages and ecological taxes. Because of that Serbia faces with the approximate amount of two million tons of various waste materials from ELVs. Some of these materials are hazardous ones [1].
In order to cope with this amount of materials the ELV recycling system has to be stable and sustainable, which primarily depends on:

- National legislation and the implementation measures;
- Automotive producer's attitude toward recycling;
- Price and market placement of used spare-parts;
- Price of recycled materials;
- Public conscience toward recycling;
- Control;

- Keeping statistics on the national level related to the ELV recycling;
- Cooperation among recyclers;
- Constant improvement of the recycling process in terms of technical capacity and knowledge.

This paper treats economical, legislative, ecological, technical and regional factors and their influence on the ELV recycling system in Serbia. Factors will be presented through the targeted recycling potentials and the possibilities of their exploitation oriented toward the recycling of passengers automobiles.

2 RECYCLING POTENTIALS

During the project [1] in the cooperation with the Ministry of Foreign Affairs, Republic of Serbia the research team collected data regarding the number of ELVs which are given in table 1. There was a special interest in determination of the average life cycle of the research objects which are given in the last column.

Table 1 Number of cancelled passengers automobiles in Serbia from 1993 to 2008 (without Kosovo)

Year	First time of registrated vehicles (number)	Registrated vehicles (number)	Registrated vehicles (number)	SUM (number)	Cancelled vehicles (number)	Average life cycle of cancelled vehicles (year)
1993	13489	42893	799549	855931		
1994	9058	30695	773133	812886	68705	13,29
1995	10698	52002	1021805	1084505	534	19,98
1996	22104	81815	911362	1015281	109976	12,15
1997	23123	100643	999301	1123067	3521	17,93
1998	21742	118560	1021591	1161893	62360	17,96
1999	18050	54549	986271	1058870	126829	15,56
2000	52403	72666	1103397	1228466	1877	21,47
2001	53145	68065	1108693	1229903	87711	18,77
2002	31963	57350	1242981	1332294	10868	17,45
2003	50470	54632	1224109	1329211	67954	18,68
2004	69333	57321	1268858	1395512	28197	21,58
2005	46934	57336	1295023	1399293	58362	21,94
2006	65798	55668	1324594	1446060	41789	23,40
2007	77576	57880	1325449	1460905	72290	21,12
2008	83663	49348	1248259	1381270	169565	20,66

It can be observed that a number of cancelled vehicles increases and that the average life cycle of a vehicle is about 20 years. These data has the importance in creating the approach to the ELV recycling. It can be concluded that these vehicles are not suitable to be a source of second-hand spare parts due to their long exploitation period. That is why we should focus on materials that are ELVs consisted of. The structure of materials in one ton of ELV is given in table 2.

Table 2 Structure of materials in bulk ELV [1]

Material/fraction	kg(material)/t(ELV)		
	2002.	2006.	2015.
Ferrous metals	680	680	650
Other metals	80	80	90
Plastics and polymers	100	100	120
Pneumatics	30	30	30
Glass	30	30	30
Batteries	13	13	13
Fluids	17	17	17
Textile fibres	10	10	10
Rubber	20	20	20
Various	20	20	20
Sum	1000	1000	1000

It can be observed that the mass of ferrous metals decreases while the mass of plastics materials increases in time, which is a trend.

As a part of the project called "Development of integrated and sustainable ELV recycling system in Serbia" [1] the estimation was made concerning the number of ELVs in Serbia in future years. The results of the estimation are given in table 2.

Table 3 Estimated numbers of ELVs in Serbia from 2008 to 2030

Year	2008	2012	2015	2018	2020	2023	2025	2030
Number of ELVs	120000	121800	134000	152000	156000	169200	178000	200000

This research also resulted with a recommendation that the Serbian automotive recycling system has to be created for more than 100000 automobiles in order to be economically sustainable.

3 RELEVANT DOCUMENTS OF THE NATIONAL LEGISLATION

The waste management system in Serbia is regulated by the Law on Waste Management (The Official Gazette of RS", broj 36/09 i 88/10). This law defines and regulates: types and classification of waste, waste management planning, waste management subjects, responsibilities and obligations in waste management, special waste stream management, terms and procedures for obtaining waste management licenses, cross-border waste transport, reporting and data base establishing, waste management funding, supervisions, penalties, etc. Targeting the area of ELV recycling a new regulation was brought in the year of 2010. This legislation act called the Regulation on End-of-Live Vehicle Management*; (*The Official Gazette of RS *"no. 98/2010)* regulates the field of ELV recycling. This document regulates the ways and processes in the ELV recycling through the activities that owners, collectors, recyclers and government officials have to conduct. Some of the most significant demands are:

- no later than 1 January 2015, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 85 % by an average weight per vehicle and year;

- no later than 1 January 2019, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 89 % by an average weight per vehicle and year.

The latter legislation act is based on the European Directive 200/53/EC, thus there are many challenges to be overcome in its implementation. These challenges are consequences of the differences between Serbia and EU countries in terms of economical, technical and political development. The implementation of the legislation acts demands thorough changes within the system, technologies, human conscience and habits.

Current conditions in the field of ELV recycling do not fulfill legislation terms. It is the consequence of the absence of the recycling system, as well as the social and economic conditions in general. This may cause stagnation and degradation in terms of technical equipment and knowledge related to the ELV recycling.

The legislative documents pay attention to the environmental friendly ELV recycling, regarding the defined transport, storage and depollution procedures and demands.

4 MODELING THE ECONOMIC SUSTAINABILITY OF THE ELV RECYCLING SYSTEM

The economic sustainability is one of the prerequisites for the self-sustainable recycling system. In order to make a distinction between systems, there are two main ELV recycling approaches: shredding and dismantling [2]. There is one automotive shredder in Serbia, but it has not been operating for a while, due to the marked demands. Thus, Serbian recyclers have been more oriented toward the dismantling approach. As we have already mentioned the ELVs in Serbia are quite old ones, so most of them are not suitable to be a source of spare parts. Because of that, there may be a strategy of combining the dismantling and shredding principle when market allows. An ELV is a potential source of many secondary materials however the most important ones are ferrous metals and copper, because of their abundance and a market price.

A model presented in Figure 1 is created based on the circular product chain principle which is given in [3]. The branches of dismantling and shredding have been presented in the model, because their combination may lead toward the sustainable system.

Based on the model of material and money flow through ELV recycling system they are targeted and their comparison has been made [4]. This model relies on one presented in [4] but it gives wider approach to the system in terms of product storage, ASR treatment, waste management.

The influence factors to benefits and costs have been recognized and included into a model.
Nomenclature [4] of factors that influence benefits:

- a_B, stock prices of secondary materials;
- b_B, amount of treated and produced materials;
- c_B, situation on the second-hand spare parts market;
- d_B, number and type of sold second-hand parts;
- e_B, producers and importers subventions;
- f_B, national stimulus packages;
- g_B, ecology funds;
- h_B, consumption of secondary materials by the national economy;
- i_B, number of ELVs.

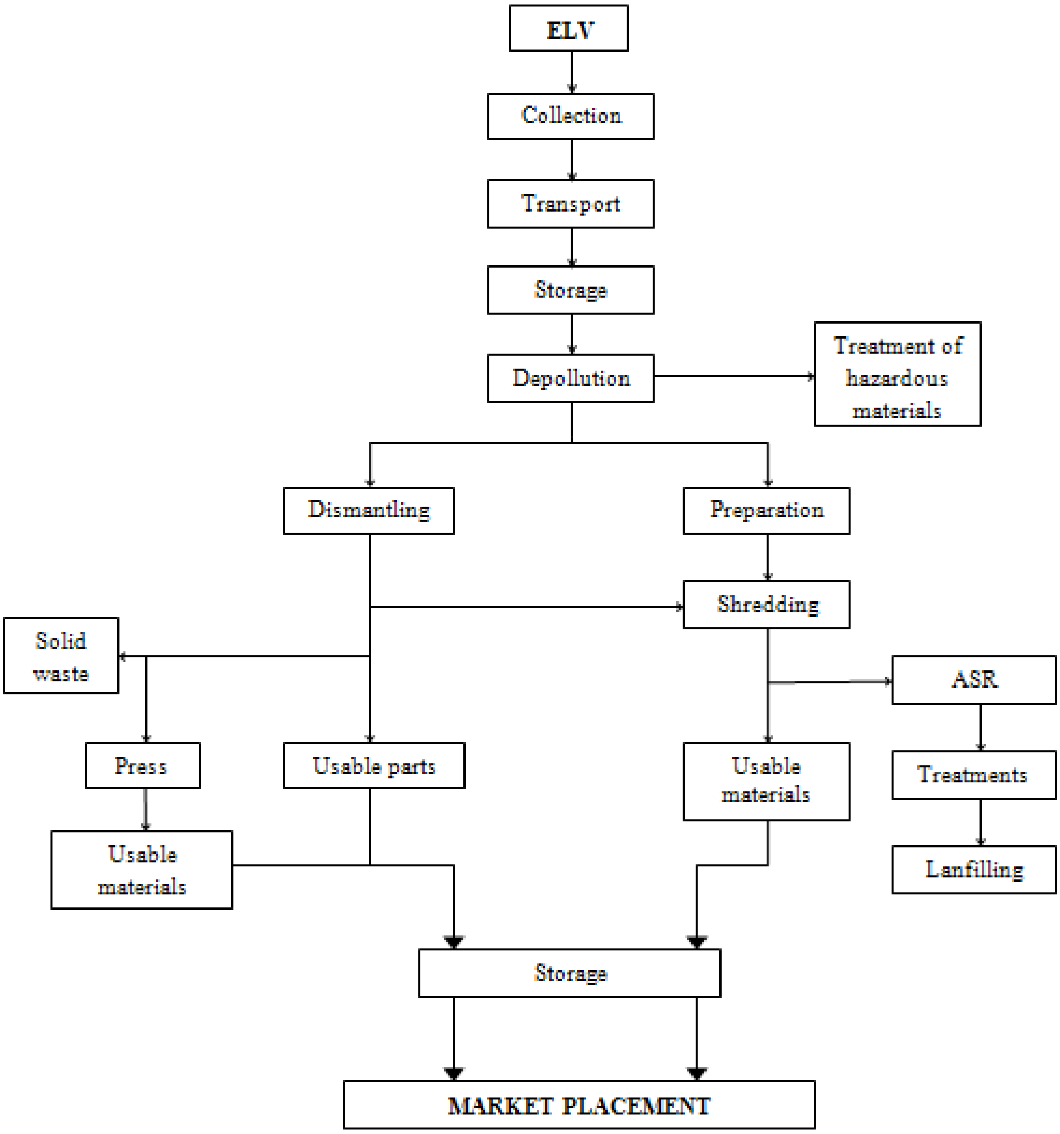

Figure 1 ELV recycling system

Nomenclature [4] of factors that influence costs of recycling system:

- a_C, collecting costs;
- b_C, transport costs;
- c_C, storage costs;
- d_C, depollution costs;
- e_C, dismantling costs;
- f_C, costs of transport to shredding facility;
- g_C, press operation costs;
- h_C, costs of cleaning and reparation of parts;
- i_C, costs of preparation for shredding process;
- j_C, shredding costs;
- k_C, costs of treatment and storage of ASR;

- l_C, material separation costs;
- m_C, product storage costs;
- n_C, human labor costs;
- o_C, energy costs;
- p_C, equipment amortization;
- q_C, number of ELVs;
- r_C, waste treatment costs;
- $_{rC}$, taxes.

Based on the given nomenclature benefits may be presented as a relation:

$$B = B(a_B, b_B, c_B, d_B, e_B, f_B, g_B, h_B, i_B) \quad (1)$$

Based on the given nomenclature costs may be presented as a relation:

$$C = C(a_C, b_C, c_C, d_C, e_C, f_C, g_C, h_C, i_C, j_C, k_C, l_C, m_C, n_C, o_C, p_C, q_C, r_C) \quad (2)$$

One of the burning topics in the area of ELV recycling is the optimal treatment of the ASR which is (15-20)% of the mass of an ELV and is treated as a hazardous waste [5]. It directly relates to the factor k_C which presents costs for the optimal treatment of ASR.

The prerequisite in achieving a self-sustainable system is the implementation of laws which are based on the costs (C) and benefits (B) that are achieved in the ELV recycling. In general, there are three possible scenarios:

- B>C, the recycling system is economically sustainable, so no subventions are needed;
- B=C, the economic profit of the recycling industry is zero;
- B<C, the recycling system is economically unsustainable, supporting subventions are necessary in order to keep system working.

5 ECONOMIC SUSTAINABILITY OF THE ELV RECYCLING SYSTEM IN SERBIA

Based on the available real-field data a calculation is done in order to determine the economic sustainability of the ELV recycling system in Serbia. In order to remain consistency we have followed the next balance equation:

$$\text{INPUT+SOURCE=OUTPUT+ACCUMULATION} \quad (3)$$

Where:

- INPUT values are: scrap metal prices, used spare parts prices and their market placement;
- SOURCE values are: government stimulus packages, ecology funds, etc;
- OUTPUT values are: ELV costs, transport costs, depollution costs, dismantling costs, shredding costs, ASR landfill costs;
- ACCUMULATION is observed through profit.

It is necessary to emphasize that many factors have not been taken into the account i.e. energy costs, storage costs, capital costs [6].

Transportation costs cover transportation distance to 50 km, automobile volume, driver's wages and vehicle amortization. About 25 ELVs can be transported using one lorry. Thus the transportation costs per ELV may vary from 10 €/ELV to 30 €/ELV.

Recyclers pay to the ELV owners about 100 €/ELV.

Depollution costs are hard to be predicted due to the many influence factors. With the equipment costs of 10000 € and 100 working days per year 8 hours a day, and the operator's salary of 700 € GROSS, where the operating time is 30 min/ELV and other costs are estimated to 2 €/ELV the total ELV depollution cost are around 5 €/ELV.
Dismantling costs are predicted through operator's time. One operator can treat 4 ELVs per day, and with the gross wages of 700 €/month the costs are 8 €/ELV.
Shredding costs are about 17 €/ELV.
ASR land-filling costs are planned to be 60 €/ton by 2015, currently cost vary from 0 €/t to 60 €/t, which makes 0 €/ELV- to 12 €/ELV.

All observed output values are summarized in table 3.

Table 4 Output values

Value	Price, €/ELV
Buying costs	100
Transportation costs	10-30
Depollution costs	5
Dismantling costs	8
Shredding costs	17
ASR land-filling costs	0-12
Total	140-172

It has been argued whether the SOURCE values are needed or not.
Shredded metal price have decreased since the year of 2010 [7]. In this calculation we will use data from the table 2 and the average prices of shredder metal in the year of 2012.
The price of the shredded metal in 2012 was 303 €/ton [7].
The income from shredded metal is 206 €/ELV. Due to the long life cycle of vehicles in Serbia they are not reliable source of used spare parts. Thus, it is estimated that the income from spare parts is about 80 €/ELV. So, total OUTPUT of an ELV is around 286 €/ELV.
Figure 2 shows the comparison of these results.

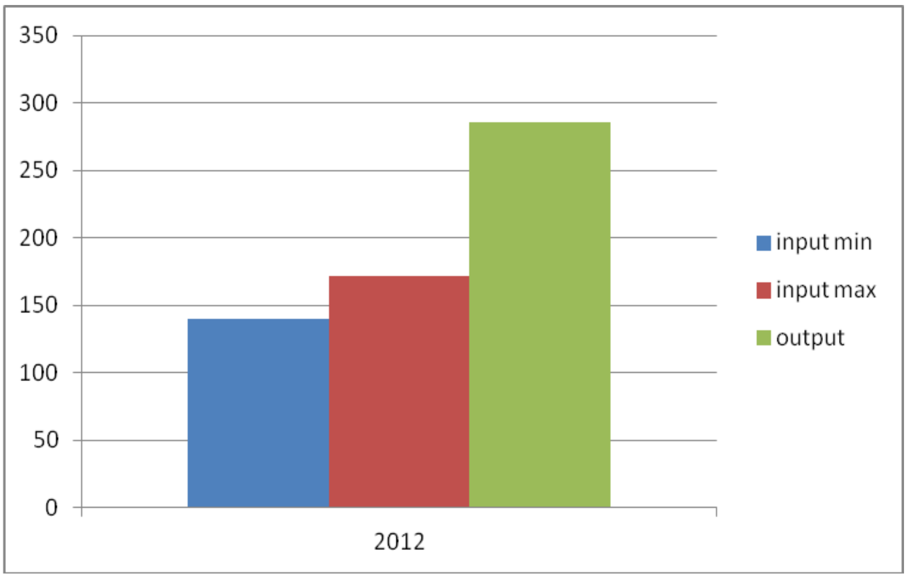

Figure 2 Input vs. output values in the ELV recycling system, year 2012

In the worst possible scenario output exceeds input for 114 €/ELV and in the best possible scenario the difference is 146 €/ELV. It may be expected that this difference will cover the hidden costs and will enable some ACCUMULATION without any SOURCE interference. Still, it has to be emphasized that a more thorough research has to be conducted in order to understand the system itself and all hidden costs that recyclers may face with.
The main reason for the potential sustainability of the ELV recycling system in Serbia is the high price of shredded metal in the world. For instance, the shredded metal price in 2012 was 303 €/t, and in 2002 it was 111,5 €/t, so its market price increased around 2,7 times. With the old prices it would not be real to expect that the system gains sustainability.

6 MODELING OF LOCATIONS OF ELV RECYCLING CENTERS IN SERBIA

Serbia consists of 25 regions (without Kosovo) and their mutual cooperation is one of the key factors for obtaining the sustainable ELV recycling system. A network of recycling centers in Serbia was projected, which was one of the results of the project “Development of integrated and sustainable ELV recycling system in Serbia”. Based on these results [1] the number of these centers is systematized in this paper.
The results about number of centers and their capacity are given in table 5.

Table 5 Calculated numbers of centers

Type of a centre	Capacity, ELV/year	Number of centers in Serbia
Line centre	5000-6000	5
Combine centre	2000-4000	13
Group of lifters	1000-2000	28
One or two lifters	300-600	107

Total capacity of this system varies from 111100 ELV/year to 202200 ELV/year.

7 CONCLUSION

With the increase of the shredded metal prices Serbian potential in ELV recycling increases. One of the reasons is the working life of the vehicles in Serbia which is higher than in more developed countries, so ELVs in Serbia have higher metal ratio. Many projects are conducted in order to create a sustainable automobile recycling system, yet many of them have not been implemented into real field actions. Almost the same situation is with the legislation, which was taken from the EU. Some technical and structural changes are needed in order to create and sustain highly efficient ELV recycling system. Modern automobiles have less ferrous metals and more plastics and aluminium than the old ones. Serbia, currently, does not have capacities to face challenges of modern recycling due to the lack of post-shredder technologies. Because of that presented results that rely on the shredded metal price may not be sustainable on the long runs with the current technical equipment of the recyclers.

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QUALITATIVE ANALYSIS OF PROBLEMS ASSOCIATED WITH WASTE DEPOSITION IN UNDERGROUND MINE WORKINGS

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Abstract: *The present-day state of generation of waste, above all of hazardous waste in the production, social and consumption spheres of our country is alarming. The existing economic aspect and economic policy are unfavourable for solving the problems associated with waste; merely an economical approach shows promise. The deposition of waste materials, which are generated by the mining and energy industries, other industrial activities and the population, in underground cavities has many advantages, which justifies the development of this approach. An underground storage site both makes it possible to prevent the civil population from contacting the waste and is separated from atmospheric effects.*

INTRODUCTION

In the last decade, an extensive discussion, often controversial, has taken place among members of professional and unprofessional public concerning the co-existence between human society and natural problems. In this discussion not only insufficient awareness, distortion and also taking of facts and phenomena out of context, but also overestimation of some items of data often appear. What undoubtedly plays here its role is the fact that the understanding of very complicated interrelationships between the natural problems and the anthroposphere is very difficult and has not achieved a sufficient level yet.

Industrial production brings, despite the utilization of modern technologies making efforts to mitigate ecological impacts of production on the environment, also some negative phenomen. Among other matters, it is a case of production of waste materials of various types, volumes, properties and effects on the surroundings.

The problems of waste materials manifest themselves especially markedly in the areas of high concentration of production – mainly heavy industries. Such a typical area is the Ostrava-Karvina agglomeration, which in addition to common municipal waste also produces an amount of waste materials associated just with industrial production. For illustration, it can be stated that e.g. according to [1] about 9 million tons of such waste are produced in the Ostrava District annually; waste from metallurgy and mining forms about 20%. By way of an introduction I want to emphasise that the overall production of solid waste residues from large electric power plants and heating plants in the Ostrava-Karvina region ranges from 1.2 million to 1.4 million tons per year.

Here, a realistic possibility of disposal of these waste materials in the mines of Ostrava-Karvina Coalfield (henceforth referred to as OKC) logically presents itself. However, it is necessary to distinguish the deposition of waste in mine workings of active mines (backfilling of worked out space in the framework of technological cycle of mining – Karvina part of OKC) and the deposition of waste in main mine workings of closed mines (Ostrava part of OKC). Cardinal questions of the deposition of waste in underground cavities include: evaluation of natural, above all geological and geomechanical conditions of the Carboniferous massif, properties of waste being deposited in relation to a mine environment and technological requirements, and technical–operational conditions of mine workings, deposition technology itself, safety of working process and economics of operation.

WASTE DEPOSITION

The waste that is utilized or can be utilized as secondary raw material in the future must be deposited so that the mixing of it with other types of waste may be avoided. This concerns above all hazardous waste. From this point of view, three types of deposition exist, namely temporary, long-term and permanent.
Temporary deposition – waste is stored until a technology for waste disposal or reprocessing is put into use. The storage of waste must be a service paid by the generator who is fully liable for waste until waste disposal is completed.
Long-term deposition – waste is stored until an economically acceptable technology for disposal is developed or until economically favourable conditions for the realization of this technology are created. It is usually the case of controlled large capacity storage sites where, similarly to the facility for temporary storage, the operator is obliged to ensure storage according to the type of chemical composition and toxicity of waste in separated boxes and to keep exact records concerning the location in the landfill site, the type, chemical composition and amount of waste.
Permanent deposition – the waste, in the case of which any potential possibility of further utilization cannot be considered from the point of view of state-of-the-art knowledge, is deposited in large capacity storage sites for unsorted hazardous waste. By accepting the waste, the operator of the storage site takes the full liability.

The present-day technical equipment of territory of the Czech Republic with waste industry facilities is, as a result of long-term total neglecting the whole range of problems of waste management, still unsatisfactory. It does not represent any integrated system and the structure of existing facilities does not correspond to the needs of and requirements for advanced and functional waste management in accordance with already valid legal regulations. In spite of some improvements, especially on the local level, any fundamental change in this area has no occurred yet [2].
The term “mining” is defined in encyclopaedias of our language space as the prospecting for and development of valuable mineral deposits, and also the extraction, drawing and processing of the minerals of the deposits. To these classical tasks, another function, namely the removing of more or less harmful waste from the environment, has been added in recent years. In the future, this area of activity will be of increasingly greater importance. In the literature, the deposition of waste materials in underground mines (Entsorgungsbergbau) [3] is already dealt with.
Waste concerned is produced by industrial and municipal plants, households and mining industry itself. In the course of processing and treatment, and also beneficiation of primary raw materials, the waste is generated that has so far been deposited prevailingly on the surface in waste dumps and sludge lagoons.
In the future, this waste must be reduced as much as possible and preferentially converted to valuable products, e.g. construction materials. Volumes produced in the future (as well as those designated as mining waste) must be given back to underground cavities more intensely than in the past. This also holds true for other types of waste outside the mining industry.

EXPECTED DEVELOPMENT IN WASTE MANAGEMENT

In advanced industrial countries, the amount of waste in all sectors of economy has been successfully markedly reduced by gradual implementing new manufacturing and treatment technologies, legislative and educational measures. This trend will be intensified further, especially in the case of waste that is or may potentially be health or environmentally hazardous. In the year 1988 a programme concerning changes in methods of waste management was prepared in the Netherlands. The programme is probably of universal validity in the EC countries, and should also be a guideline for our waste management [2].

This programme is based on the fact that manufacturing processes and also methods of consumption produce unavoidable “losses”; it means that waste is necessarily transmitted to the environment. At present, quite a number of products during the manufacturing of which waste unable to be utilized as secondary raw material is generated are still manufactured. Modern approaches to solving the problems of waste management require, however, two fundamental items as given below:

- the limitation of losses in the course of manufacturing process,
- the limitation of adverse influences of losses made during the consumption and utilization of products.

The efficient method of loss prevention should be the manufacturing of long life products. Nevertheless, the longer is the life of the product, the greater are the problems of disposal of it as waste.
The objective of preventive measures is to remove all processes, during which harmful substances that are capable of being transferred to the environment are formed. However, the prevention means a change in manufacturing process, development of a new process also by using other raw materials, from which as little as possible waste would be generated. This concept is the cornerstone of wasteless technologies. For solving these problems, the International Association for Wasteless Technologies was established. It has a seat in Vienna and is a non-governmental and non-profit organization.

CHARACTERISTICS OF WASTE DEPOSITION IN UNDERGROUND CAVITIES

In the future, waste deposition in underground cavities may contribute substantially to environmental protection. In the foreground the recovery of waste from the mining industry and also from other industries for the use in mining must be. This is possible in the form of construction and filling materials for application in mining. With the ever increasing demand for construction materials underground, merits of these materials in the areas of safety, rock mechanics and support technology can be connected in this way with the long-term safe disposal of industrial waste in underground cavities. As well, the long-term deposition of waste containing toxic/radioactive harmful substances in rock formations below the surface is possible. Long-term safety is ensured by the geological and technical system of multiple barriers. The deposition and/or storage can also be performed with a possibility of re-use or without this possibility in suitably adjusted cavities, rooms, caverns and deep boreholes [4].
In the course of underground mining of deposits, underground cavities are created that are filled for some reasons, especially safety reasons, spontaneously (caved-in surrounding rocks) or backfilled with other materials. The use of backfill in a rather high degree is required mainly at present for safety and ecological reasons. As basic material, mining and non-mining waste is used. The filling of mined-out and other cavities during the mining of economic minerals provides, independently of economic efficiency, advantages from the

point of view of both safety (more efficient ventilation and more favourable climatic conditions are obtained) and ecology (protection of surface and landscape features). These merits will even be increased, if the disposal of waste that could otherwise cause problems in the area of environment is thereby enabled. This leads us again to the idea to create and use underground cavities merely for this purpose – for the deposition of harmful substances. Thus in the mining industry, the importance of waste disposal grows continuously, because the classical backfilling of worked-out areas is supplemented by the utilization and subsequent deposition of ecologically harmful waste in the existing underground cavities or in deep cavities formed for this purpose. If the disposal of waste is the main or even a single purpose of mining, then new aspects, tasks and problems appear here.

REASONS AND PRECONDITIONS FOR UNDERGEROUND DEPOSITION OF WASTE

The current state of generation of waste, above all of hazardous waste in the production, social and consumption spheres of our country is alarming. This unfavourable situation, especially in relation to instantaneous possibilities of changes in manufacturing technology itself that would lead to a radical turning point in waste management (volume minimization, recycling, secondary recovery, etc.), necessitates the immediate search for paths to the limitation or elimination of contact between waste already produced and still being produced and its surroundings.
The present-day economic aspect and economic policy are unfavourable for solving the problems associated with waste; what has a good chance of success is merely such approach that will be economical in the nearest future. From this a possibility of solving only some, rather simple and easy problems of waste management follows logically.

There is a sufficient amount of reliable and verified data, acquired by the long-term geological-exploratory and mining activity, on the fact that in the territory of our country some territorial areas with suitable conditions exist. The efficient solving of basic problem in the given space and time is the construction of suitable storage sites for non-hazardous as well as hazardous waste in suitable geological, hydrogeological and geotechnical conditions with the utilization of capacity of existing underground mines and underground mines being decommissioned (closed). In this way, the operation of underground storage sites is possible on the present-day world level as prospective activity in the mining business.
This approach is characterised by the existing requirements and also results expected:

- A favourable rock environment is the most efficient safety barrier; the location of structures underground almost eliminates the access of unauthorized persons and action of surface influences (changes in temperature, solar radiation, etc.).
- The changeover of selected mining capacity to the operation of long-term storage sites, and in the future also sites for the permanent underground storage of waste further increases the value of investments already made and investments written-off for the greater part, as regards main development mine workings, transport roadways and equipment, and energy, pumping and ventilation systems.
- An activity in the rock environment is a specialized matter for the immediate circle of workers with acquired habits for underground stay and work. The sectors of mining and underground construction have suitable technical equipment and technologies for the creation of new cavities in the rock mass without excessive damage to rock in the surroundings of excavation.
- The construction and operation of underground storage facilities and sites preserve job opportunities for specialised professions and skilled workers.

- The changeover from mining to deposition of waste in underground mines is less time-consuming that the realization of new building projects on the surface. The construction and the operation of storage sites with the utilization of existing capacities do not put any requirements for appropriations of land; neither the building of new energy and medium supply systems as well as the construction of new roads are required, not the surroundings are disturbed by other unfavourable effects, such as noise, dustiness, etc.

What can be regarded as one of steps leading to a system, technically clear and safe approach for the design, construction and operation of underground storage sites for various types of waste is the elaboration of basic technical conditions for underground waste deposition in a form of a regulation, or low-level standard. This regulation should aim at:

- Defining a uniform framework for solving specific cases and ensuring a turn-key solution.
- Ensuring a system approach to the establishment and operation of underground landfills.
- Creating a basis for the elaboration of high-level standard documentation.
- Supplying evidence of the reliability and safety of designed structures and facilities for underground waste deposition to the professional and the unprofessional public.
- Elaborating in detail and implementing efficient tools for environmental protection (audits, etc.).

CONCLUSION

Industrial production brings – in spite of application of state-of-the-art technologies that try to mitigate the ecological impact of production on the environment – also some negative effects. Among other matters, it is the generation of waste materials of various types, volumes, properties and effects on the surroundings.

The deposition of waste materials from the mining and energy industries and a whole series of areas of industrial activity of life of population (municipal waste) into underground cavities have many advantages justifying the development of this technology. For instance, it is the fact that an underground storage site both makes it possible to prevent the civil population very well from direct contacting the waste and is separated from atmospheric effects. What belongs to the advantages is also the fact that underground deposition can solve even the problem of a lack of surface localities suitable for landfill construction. On the other hand, it is however necessary to pay great attention to the preparation, operation and closure of underground storage sites, because the subsequent possible removing of errors and handling of accidents are here usually more difficult than in the case of surface landfills.

Supplement No. 1: An example of laboratory test on washed fly ash from the ČSM Mine, South plant, crosscut No. 3301 and dam No. 3154

Test Report	
Type of sample	Waste - fly ash washed from mine
Sample Number	2465/1505
Taking place	CSM mine south crosscuts No. 3301 and No. 3154 barrier
Sampling date	18. 3. 1996
Date of receipt of sample (LAA)	19. 3. 1996

Date of examination	19.3.-9.4. 1996
Customer	HP pro EKO - KARJBO, a.s. Ostrava
Retired	RNDr. Urbanec

Concentrations of substances in aqueous extract of 1: 10				
Pointer	**2465/1505**	**Units**	**Methods**	**Bug fixing (%)**
Solids	57,9	%	Gravimetric	
pH	11,1	/	Electrometry	5
Solute	1044	mg/l	Gravimetric	5
Conductivity	133,1	mS/m	Electrometry	5
Smell	0	/	Sensory	/
Phenol index	<0,017	mg/l	Photometric	10
CHSK-Cr	10	mg/l	Titration	10
NEL	0,022	mg/l	IC	10
Anionic surfactants	<0,040	mg/l	Photometric	10
Ca	173	mg/l	AAS	10
Mg	0,6	mg/l	AAS	10
AI	1,5	mg/l	AAS	10
Sb	<0,002	mg/l	AAS	10
As	<0,002	mg/l	AAS	10
Ba	0,2	mg **1**	AAS	10
Be	<0,00005	mg/l	AAS	10
B	0,02	mg/l	ICP	10
Pb	<0,03	mg/l	AAS	10

Concentrations of substances in aqueous extract of 1: 10				
Pointer	**2465/1505**	**Units**	**Methods**	**Bug fixing (%)**
Cd	<0,003	mg/l	AAS	10
Cr total	<0,04	mg/l	AAS	10
Cr^{VI+}	<0,01	mg/l	Photometric	10
Fe	0,05	mg/l	Photometric	
Co	<0,04	mg/l	AAS	10
Cu	<0,04	mg/l	AAS	10
Mn	<0,02	mg/l	AAS	10
Ni	<0,04	mg/l	AAS	10
Hg	<0,001	mg/l	AMA	10
Se	<0,002	mg/l	AAS	1(1
Ag	0,01	mg/l	AAS	10
Ti	<0,002	mg/l	A \S	10
V	0,034	mg/l	AAS	10
Zn	<0,01	mg/l	AAS	10
Sn	0,089	mg/l	Polarographic	10

Fluorides	0,36	mg/l	Photometric	10
Ammonium	1,l	mg/l	Photometric	5
Chlorides	108,5	mg/l	Titration	5
Total cyanide	<0,004	mg/l	Electrometry	10
Free cyanide	<0,004	mg/l	Photometric	10
Nitrates	<3,7	mg/l	Photometric	5
Nitrites	<0,017	mg/l	Photometric	5
Phosphates	0,04	mg/l	Photometric	5
Sulfides	<0.05	mg/l	Photometric	10
Sulphate	510	mg/l	Polarographic	5

Total content of substances in the dry				
Pointer	**2465/1505**	**Units**	**Methods**	**Bug fixing (%)**
Free cyanide	<5,0	mg/kg	Photometric	10
NHL	10	mg/kg	IC	10
Phenol	<5,0	mg/kg	Photometric	10
Hg	0,29	mg/kg	AMA	10

Supplement No. 2: Results of analyses of the ecotoxicological test
ECOTOXICOLOGICAL TESTS

Ecotoxicological tests were carried out in a toxicological laboratory of Ekotest Hradec Kralove. To these tests, the coarse fly ash, from which a water extract was prepared according to the standard procedure, was subject. The extract was biologically tested using acute toxicity tests under the following conditions:

- Test on fish – Poecilia reticulta
  - temperature was 23°C,
  - exposure duration was 96 hours (evaluation every 24 hours),
  - 10 pieces in each concentration, 3 parallel determinations,
  - 150 ml per 1 organism,
  - without heating and aeration.
- Test on water fleas – daphnia magna
  - temperature was 23°C,
  - exposure duration was 48 hours (evaluation every 24 hours),
  - 10 ml of solution per 1 organism,
  - organism age was 6 – 24 hours,
  - 10 pieces in each concentration, 6 parallel determinations.
- Test on plant seeds – Sinapis alba
  - temperature was 25°C,
  - exposure duration was 96 hours (evaluation every 24 hours),
  - 10 ml of solution per one dish,
  - 30 pieces in one dish, 3 parallel determinations.

RESULTS OF ANALYSES

- Content of dissolved substances in water extract – 630 mg.l^{-1},
- Water extract pH – 9.1,
- Test on fish: Poecilia reticulata EC/1/50 – not determined, fish death did not occurred,
- Test on water fleas – Daphnia magna EC/1/ – not determined, organism death did not occurred,
- Test on plant seeds: Sinapis alba EC/1/50 – not determined, 20 percent stimulation of root growth.

From the results of the ecotoxicological tests it follows that the fly ash from the Detmarovice Power Plant does not show in the acute toxicity tests any toxic effects on organisms tested. On the basis of Guidelines on Assessment of Solid Industrial Waste Risk Level issued by the Chief Main Health Officer as Supplement No. 3/1989 to AHEM, we can classify the waste tested in category IV, i.e. toxicologically harmless waste.

These results show the suitability of deposition of fly ash from the Detmarovice Power Plant in underground cavities created and being created by mining activity because the fly ash is hygienically harmless.

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PROGRESSIVE CLIMATE MITIGATION CONCEPT FOR A SUSTAINABLE WORLD

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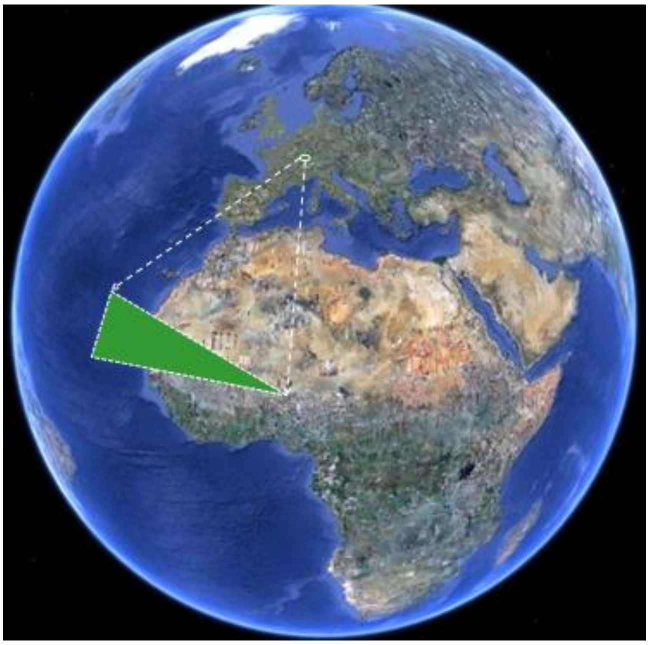


Climate mitigation has become one of the key issues of the sustainable World in the XXIst century. Current methods with renewable energy use or CO_2 emission limitation by law, the Carbon Capture and Storage are seriously affecting the world economy, increasing cost, unfair competition and tension. It's time to introduce a fundamentally new approach such as the Progressive Climate Mitigation (PCM), a concept based on scientifically developed bio-engines. The initiated method make it possible to get more CO_2 absorbed than the World yearly output, boosts biomass utilization through the rehabilitation of wastelands and stops or returns the desertification of the Earth.

A scientifically developed new hybrid of Paulownias - the Smaragd tree - has been tested on the Hungarian Great Plain for more than 3 years with reassuring result. Universities and state labs are participating in the extension of the program which determines the large multipurpose use of this plant beside its elevated CO_2 absorption, fast growing character and good intercropping capacity in sandy areas. Above extremely high CO_2 absorption 26 other positive outputs have been identified in a value chain. Among them the leaves protein content (feedstock), micro climate moderation efficiency, honey production or the extra high ash melting point are among the surprising results. The author has spent years in Africa and has been an energy expert for more than 20 years, moreover is a lecturer in climate mitigation .He has also analyzed the running Sahara desert programs such as Deserted or the Great Green Wall projects and worked out his own progressive concept. His vision "The

Green Sahara" supports the Progressive Climate Mitigation requirements both in dimension and multipurpose approach.

Through the reforestation of the desert, production of renewables parallels with increased feedstock and food production this could become an engine of Africa's upraise, if not that of the World economy. The 2200 km long green corridor from the Atlantic Ocean to the shrinking Chad-lake - is to be based on continuous green nap of artificial quadrates which are supported with new technological inventions such as the multifunctional and horizontal off-shore wind turbines (for cloud over-saturation and energy production) moreover solar chimneys with levitation turbines (for orienting the moisture towards the green quadrates). The quadrates natural depression will accommodate the rain and the Sahara desert – after about a hundred million years – can become green again!
The PCM concept can be useful in other parts of the World too converting wastelands into an eco-paradise. PCM does not only contribute to the sustainable World but could become an engine of the World economy in the next 30 years!

Most serious global issues of the XXI century

- Climate change mitigation
- Renewable energy utilisation
- Nutrition & water management
- Unemployment decrease

Global warming manifestation:

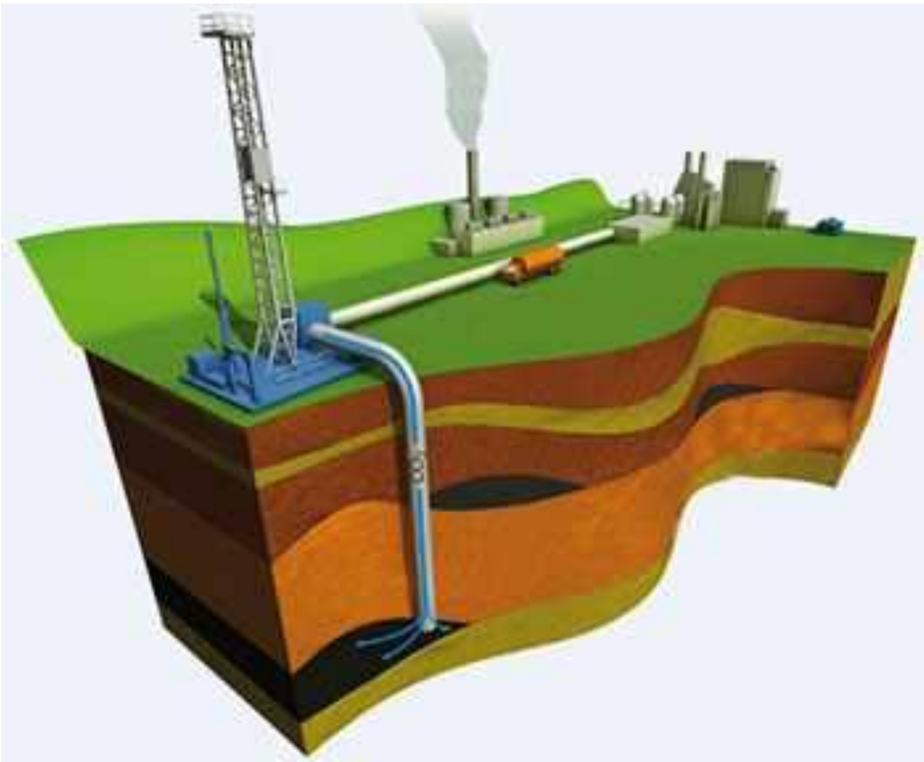
Ecological disasters: the Caspian Sea, the Aral Sea as well as the Lake Chad is to disappear

In the heart of Europe the picture is more contradictional

Hungary the same year had a draught and flood in 2013!

Global economic growth enhances climate change dangers

Does a conservative solution efficient enough in targeting EU directives?



- Decrease of CO_2 emission by 2020
- Carbon quota limitations and pricing
- Carbon capture and storage → **Versus European competitiveness!**

A progressive solution can be driven by a particular „bio-engine”

- Scientifically developed plant
- Improved vital capacity
- Would compile with EU directives
- Its multipurpose character helps to target different issues

„Smaragd tree” a Paulownia-hybrid is the bio-engine of XXIth century?

- Originated from China
- Crossbreeding resulted in astonishing capacities
- With intercropping refers to the most pressing humanitarian demands

Minimal conditions of Smaragd tree plantation

	Parameters	Limits
1.	pH value of soil	5,00 – 8,50

2.	**Salt content of soil**	**Below 1 %**
3.	**Water level below surface**	**-2 m**
4.	**Elevation**	**Max 600 m**
5.	**Average mid-temperature**	**13 – 25 C°**
6.	**Maximum temperature**	**+ 40 C° (+60 C°)**
7.	**Minimum temperature**	**- 25 C° (-31 C°)**
8.	**Monthly precipitation**	**50 mm**

Experimental value on the Great Hungarian Plain

Regional references –Szerencs plantation

European Green Island – with the utilization of wastelands

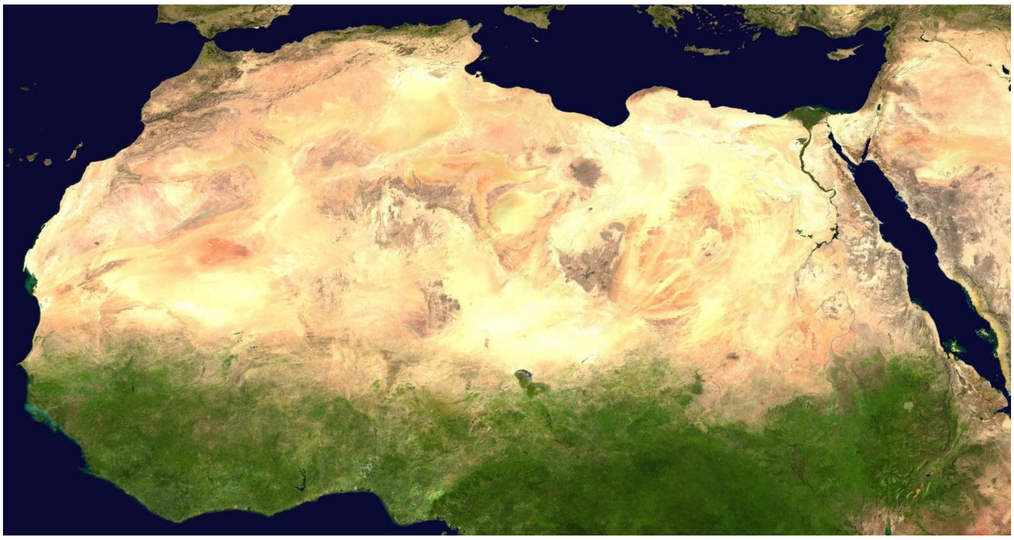
2,0 million hectares military playground
1,2 million hectares Great Plain
0,5 million hectares roadside
0,5 million hectares protective line

4,2 million hectares wasteland

4,2 million hectares reforestation with Smaragd tree could result in 630 million tons of CO_2 quota, equivalent of about 4 billion USD

Intercropping *with Lucerne, soy, beans, grains*

Let's look at the World Playground (as unique chance of humanity?)
The SAHARA

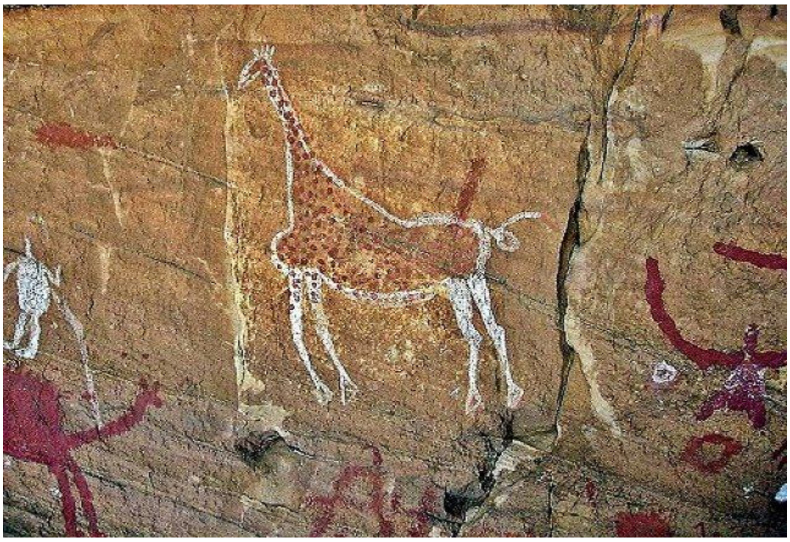


- 9 400 000 km^2 and 2 000 000 population
- Inexhaustible renewable energy source and future pioneer work for potentially 350 million people
- Is it perhaps a solution for jobless, too?

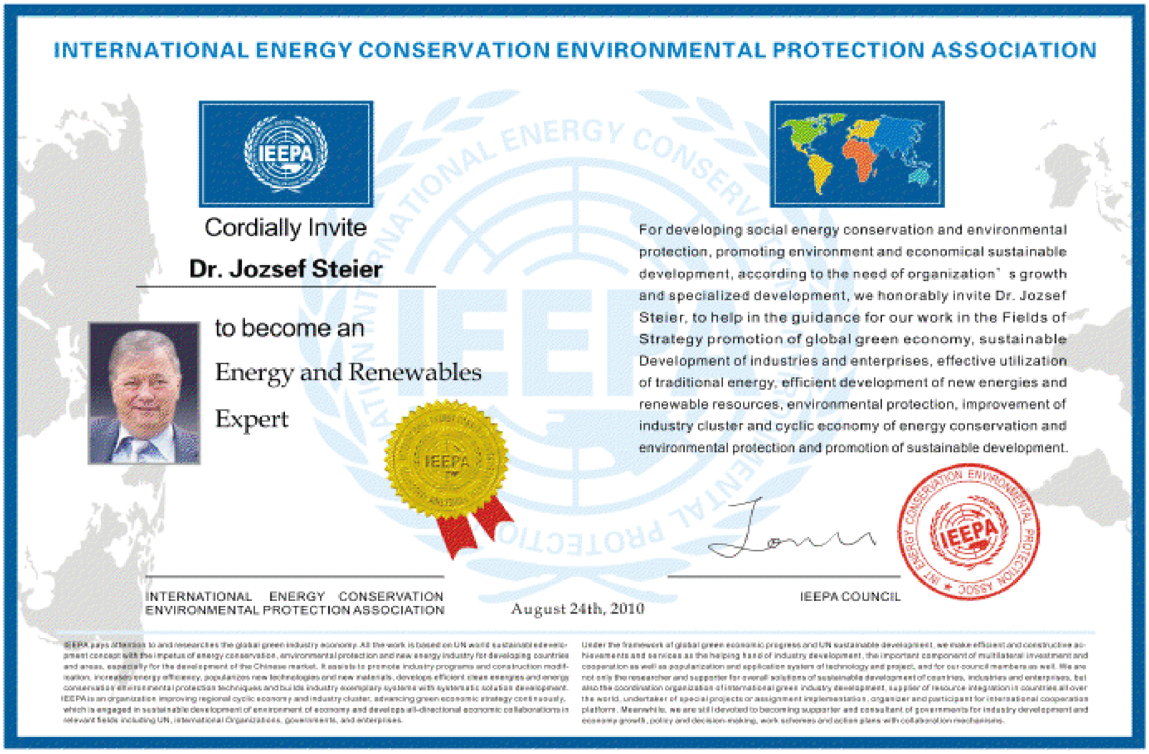
Integration of Smaragd tree with Sahara programs

- Green Wall Project initiated by former Nigerian president Obasanjo can be extended with Smaragd tree quadrates using its intercropping capabilities
- Thus 1/3 of Sahara can produce biomass, food and absorb huge quantity of CO_2

Let's promote the progressive climate mitigation concept and make the Sahara green again!



Thank you for your attention!



INTERNATIONAL ENERGY CONSERVATION ENVIRONMENTAL PROTECTION ASSOCIATION

Cordially Invite

Dr. Jozsef Steier

to become an

Energy and Renewables

Expert

For developing social energy conservation and environmental protection, promoting environment and economical sustainable development, according to the need of organization' s growth and specialized development, we honorably invite Dr. Jozsef Steier, to help in the guidance for our work in the Fields of Strategy promotion of global green economy, sustainable Development of industries and enterprises, effective utilization of traditional energy, efficient development of new energies and renewable resources, environmental protection, improvement of industry cluster and cyclic economy of energy conservation and environmental protection and promotion of sustainable development.

INTERNATIONAL ENERGY CONSERVATION ENVIRONMENTAL PROTECTION ASSOCIATION

August 24th, 2010

IEEPA COUNCIL

IEEPA pays attention to and researches the global green industry economy. All the work is based on UN world sustainable development concept with the impetus of energy conservation, environmental protection and new energy industry for developing countries and areas, especially for the development of the Chinese market. It assists to promote industry programs and construction modification, increases energy efficiency, popularizes new technologies and new materials, develops efficient clean energies and energy conservation environmental protection techniques and builds industry exemplary systems with systematic solution development. IEEPA is an organization improving regional cyclic economy and industry cluster, advancing green economic strategy continuously, which is engaged in sustainable development of environment of economy and develops all-directional economic collaborations in relevant fields including UN, international Organizations, governments, and enterprises.

Under the framework of global green economic progress and UN sustainable development, we make efficient and constructive achievements and services as the helping hand of industry development, the important component of multilateral investment and cooperation as well as popularization and application system of technology and project, and for our council members as well. We are not only the researcher and supporter for overall solutions of sustainable development of countries, industries and enterprises, but also the coordination organization of international green industry development, supplier of resource integration in countries all over the world, undertaker of special projects or assignment implementation, organizer and participant for international cooperation platform. Meanwhile, we are still devoted to becoming supporter and consultant of governments for industry development and economy growth, policy and decision-making, work schemes and action plans with collaboration mechanisms.

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